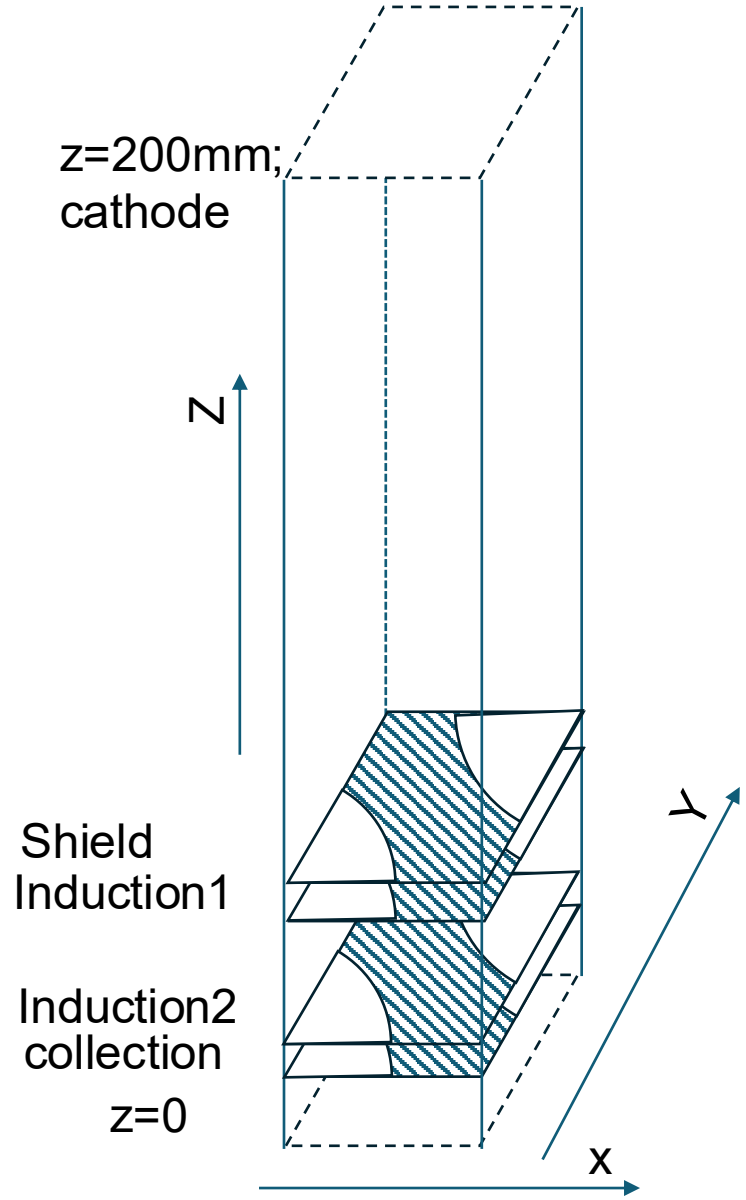
# Field response check in PDVD

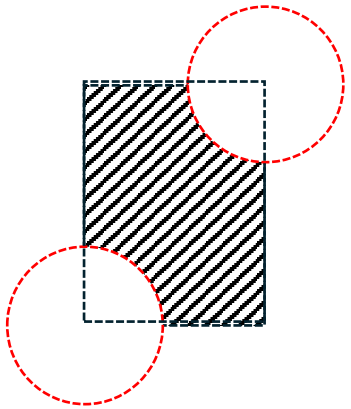
Xuyang Ning

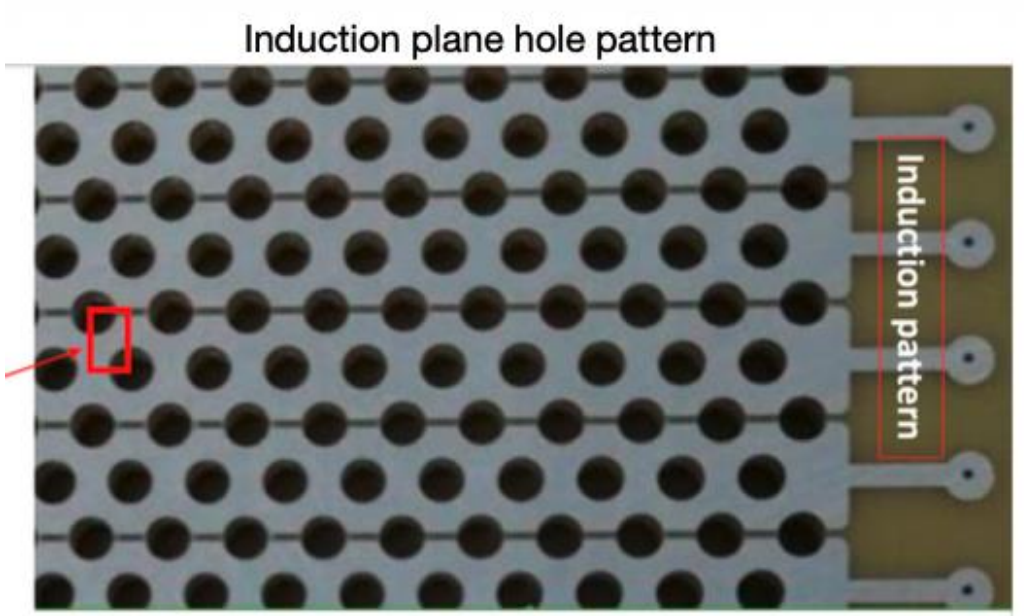
Brookhaven National Laboratory

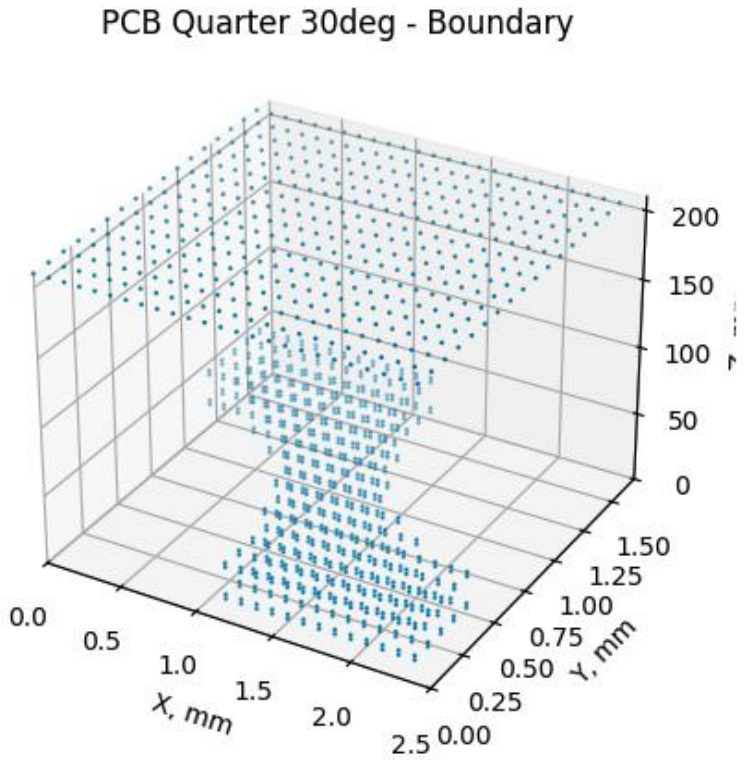
# 3D Drift field

Minimal symmetry for Drift Field



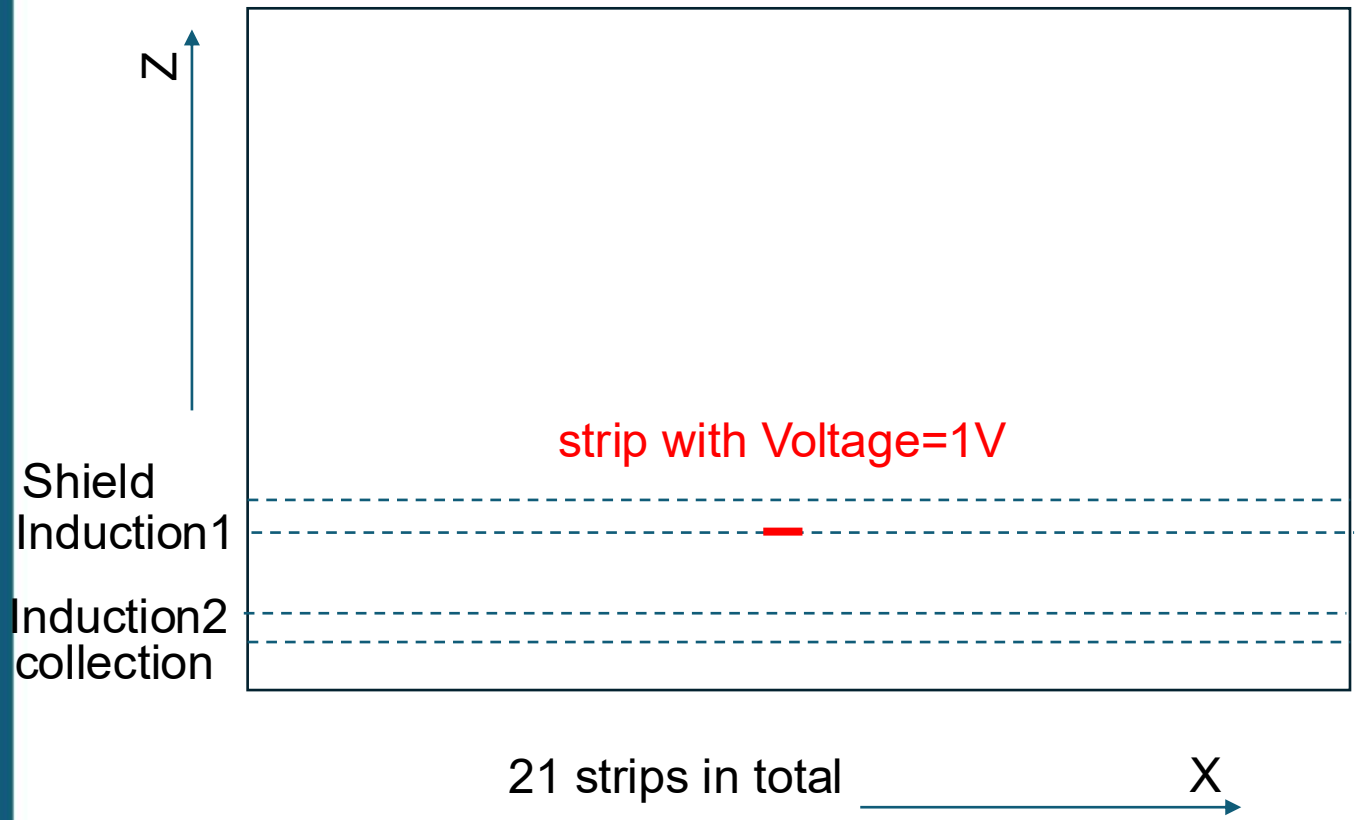


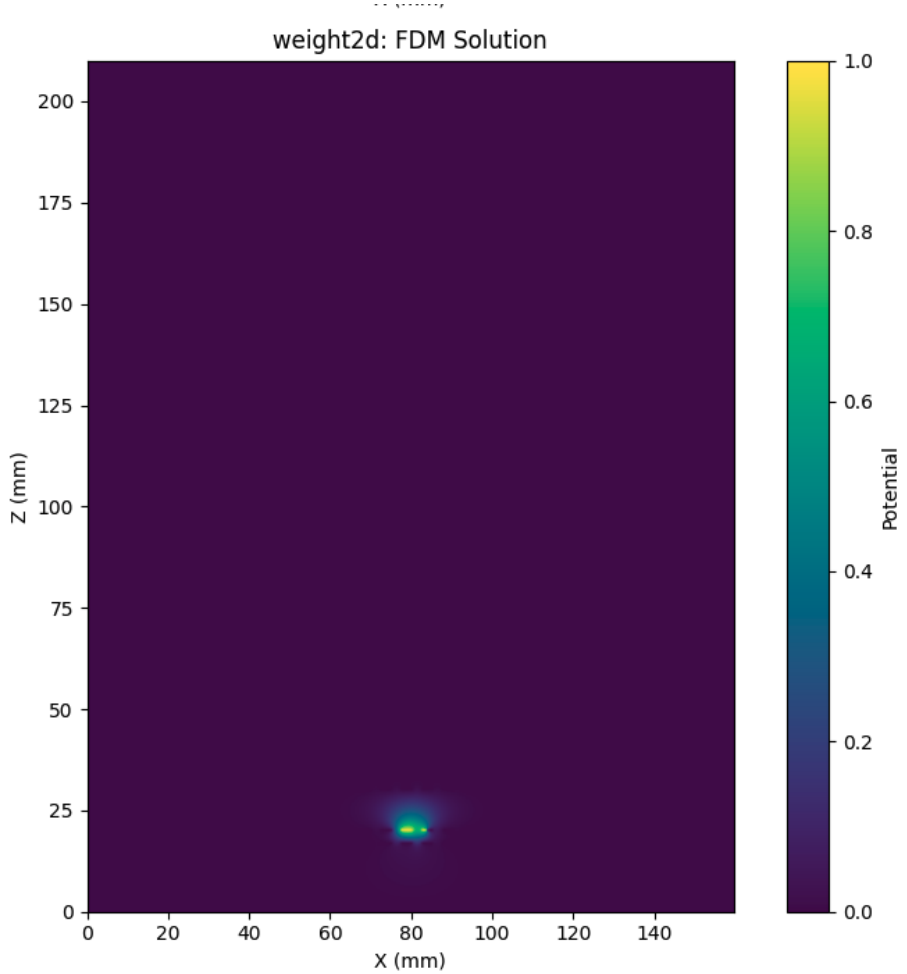




2 arrays to describe:
one for boundary;
one for voltage.

Then solved by FDM.

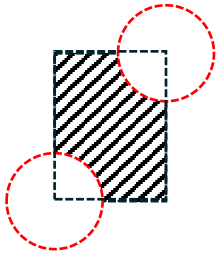
# 2D weighting field

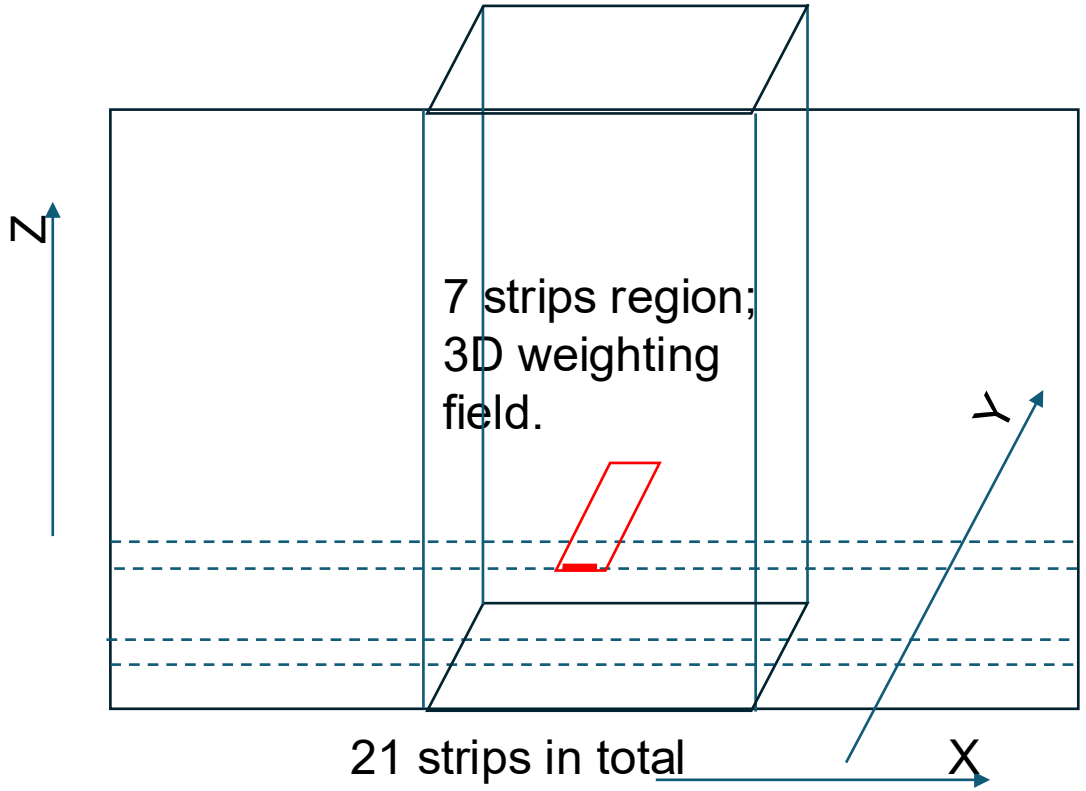


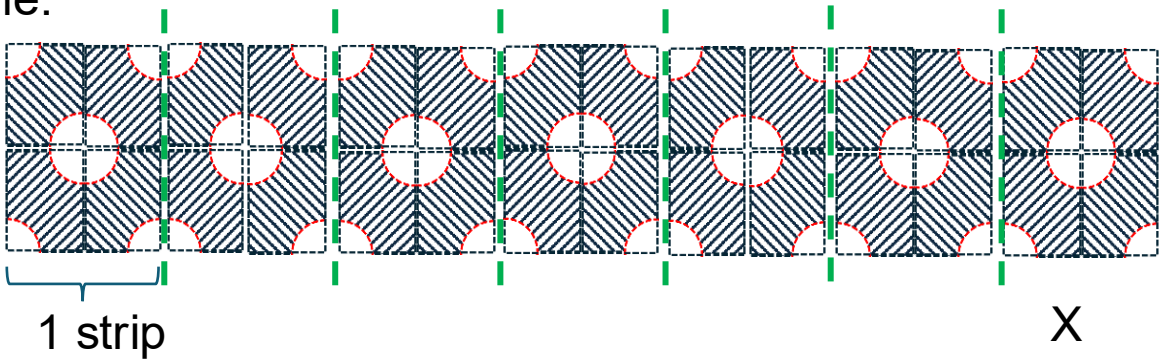
# 3D weighting field

⊗, strip direction

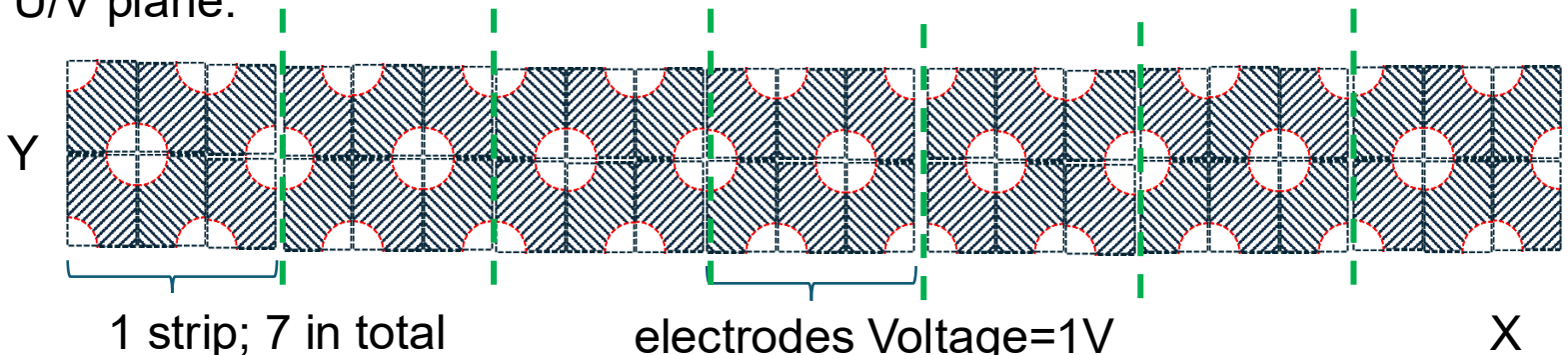





W plane:

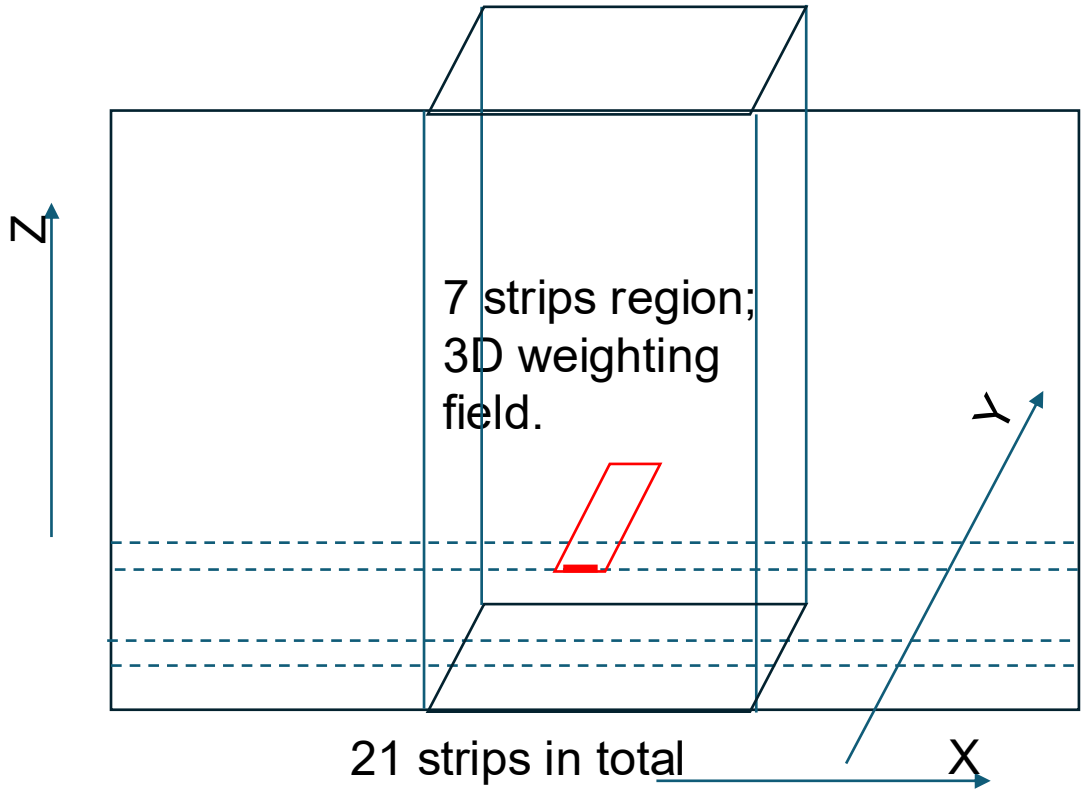



U/V plane:

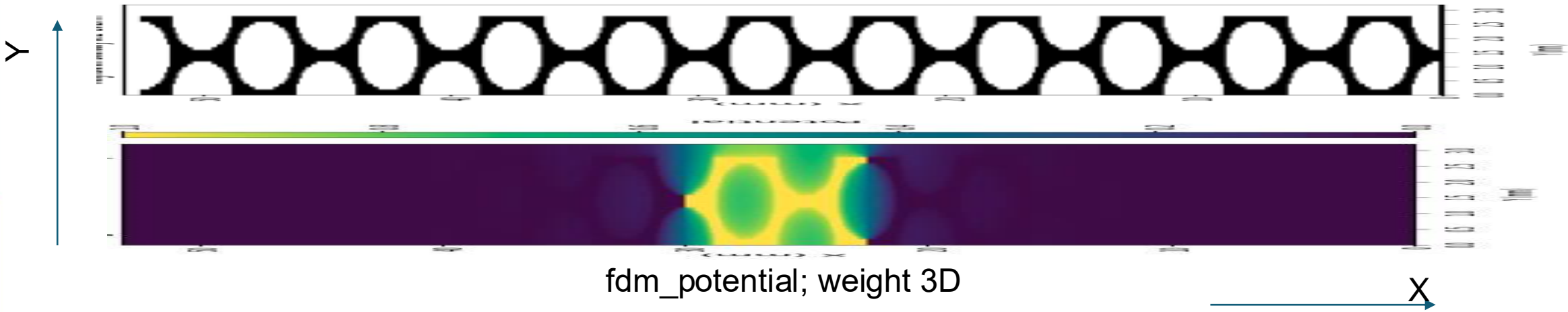


# 3D weighting field

initial value on boundary is got from 2D weighting field solution.



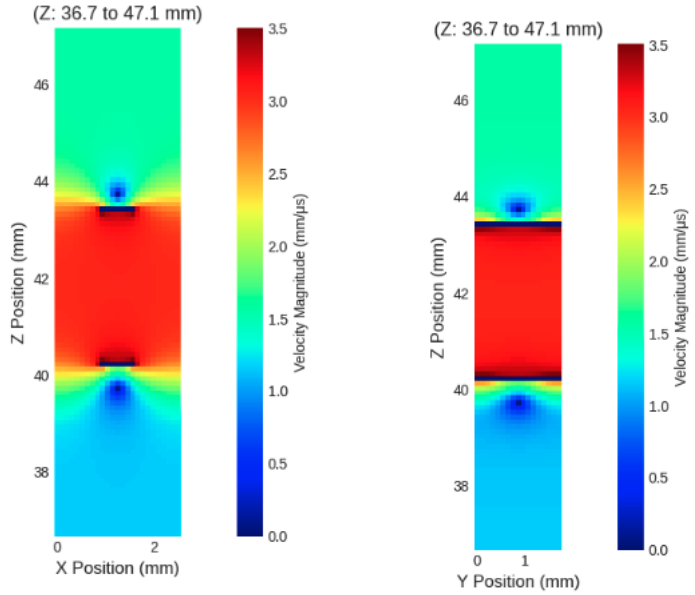

boundary




fdm_potential; weight 3D

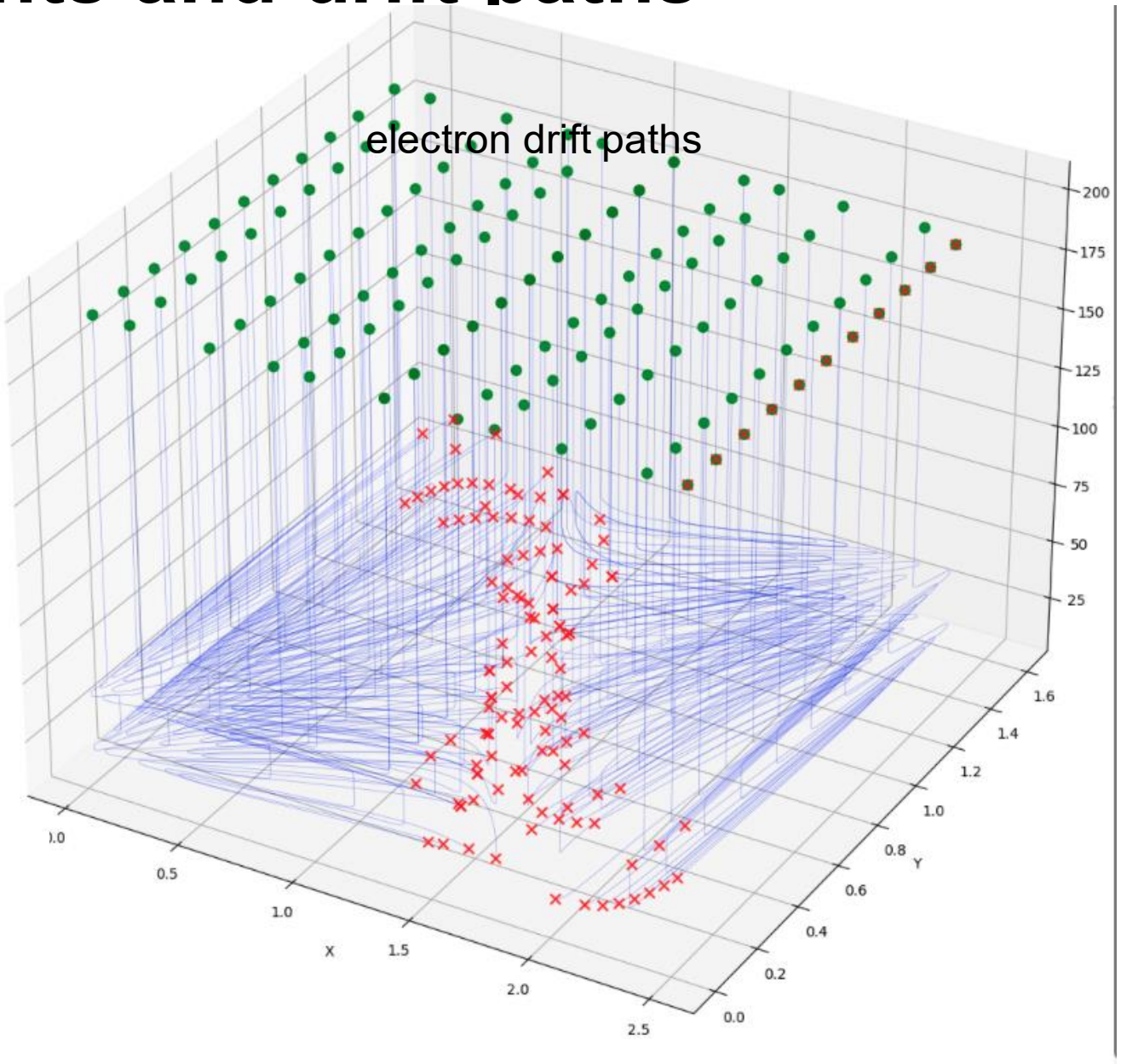
# Velocity, starting points and drift paths

velocity distribution

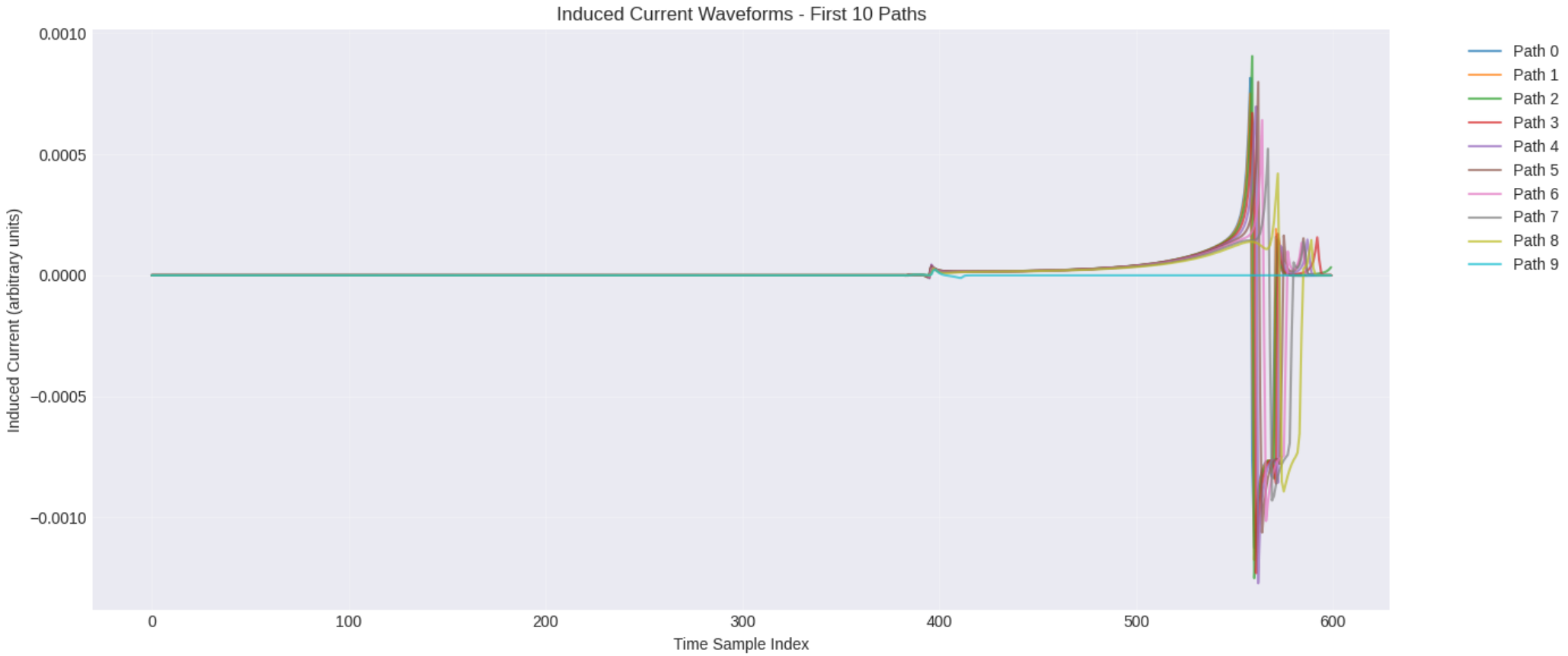



```
Drift Velocity Magnitude:
  |v| range: [0.0000, 3.5935] mm/µs
  |v| mean: 1.4554 mm/µs
```

electron drift paths

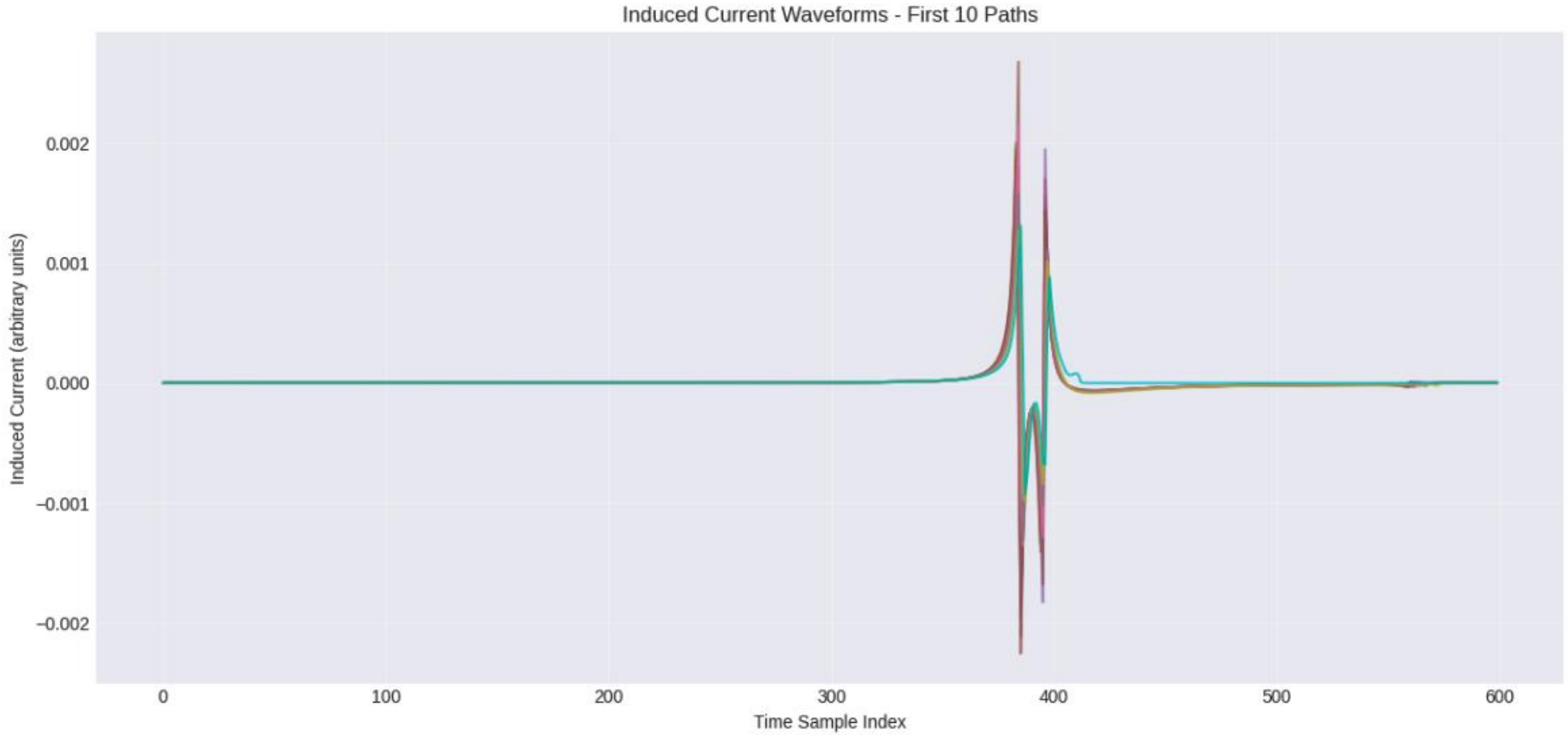


# Induced current on v



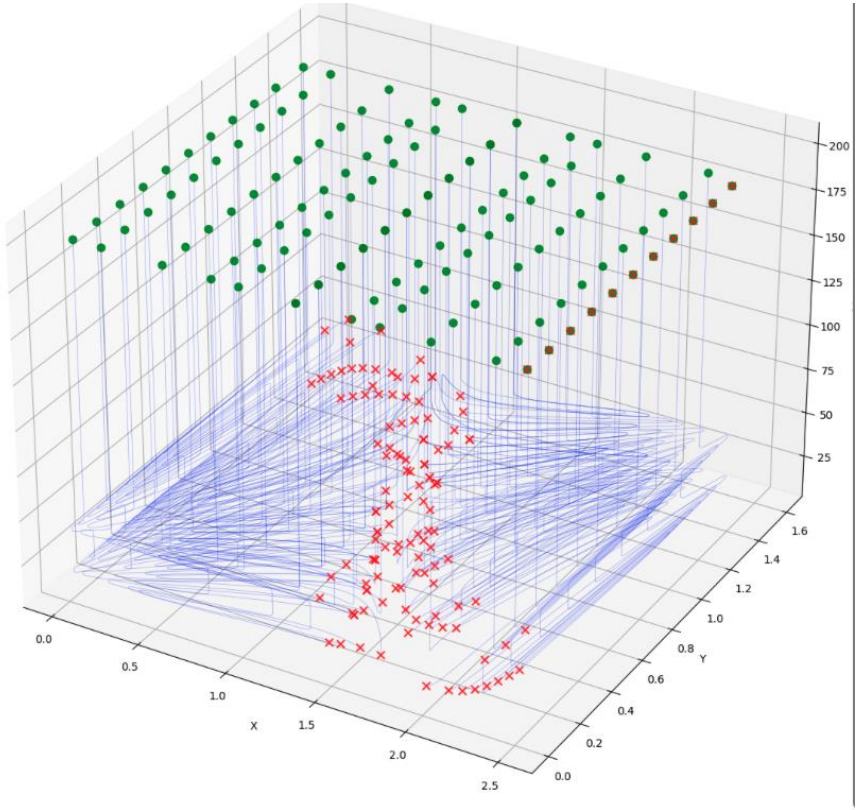

Induced current calculated using Ramo's theorem $i = -e \times \vec{v} \times \vec{E_w}$

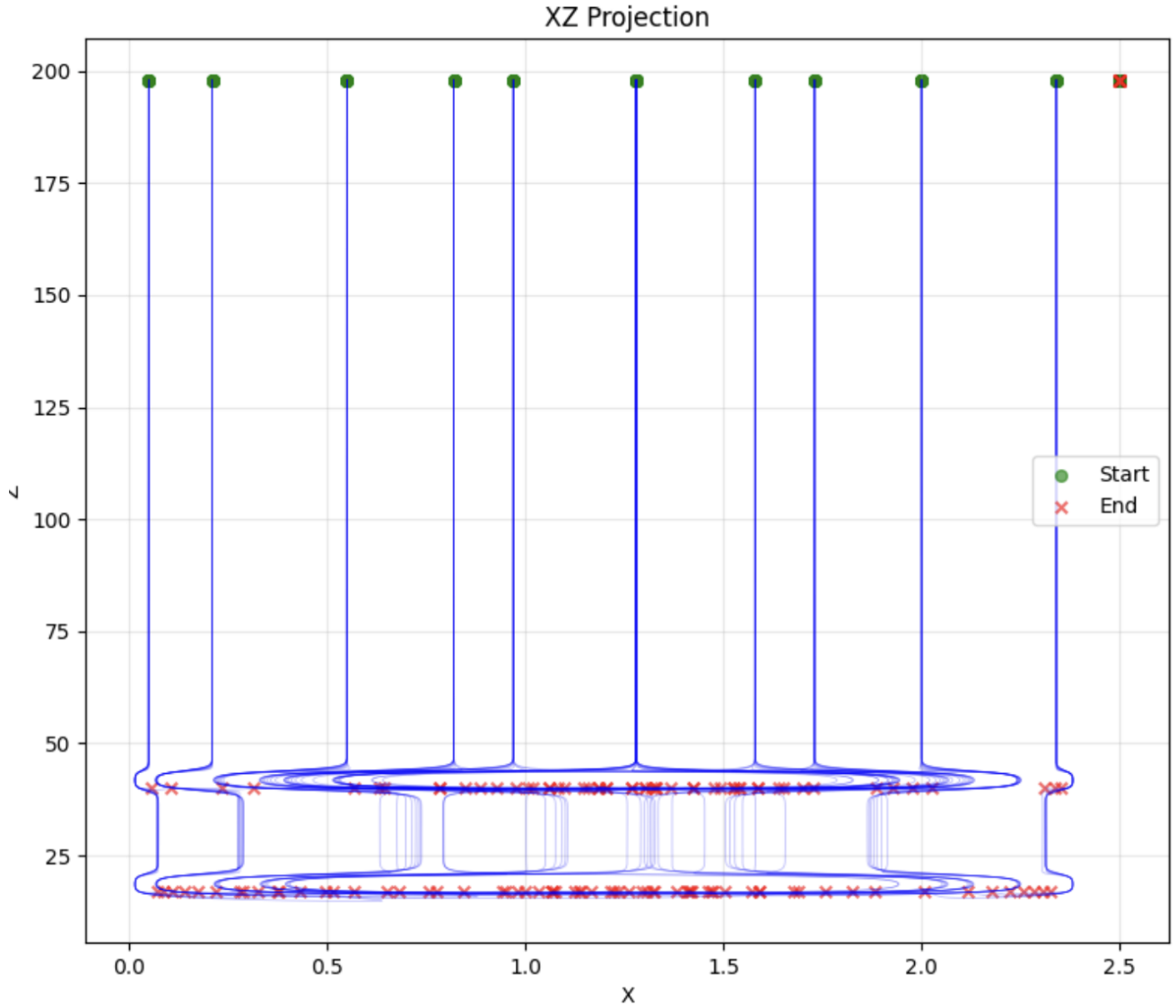
# induced current on u




This is weird…I am still checking

# Drift path from last time:

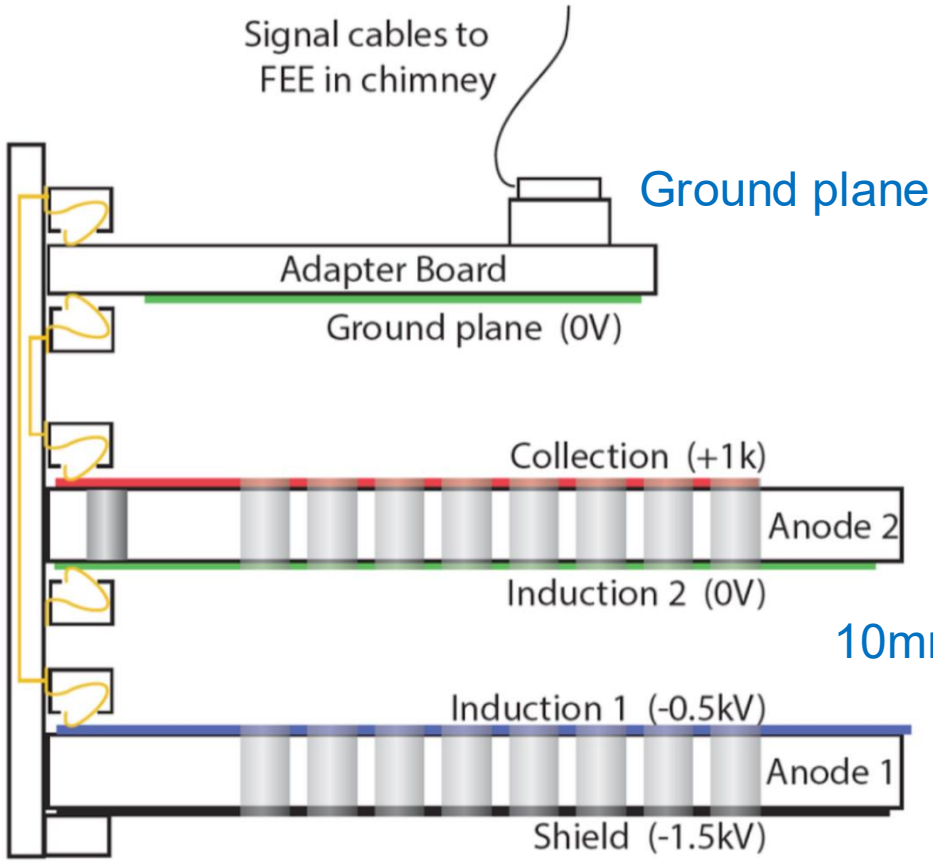



some path ends at u;
due to the wrong geometry

# Check geometry in detail

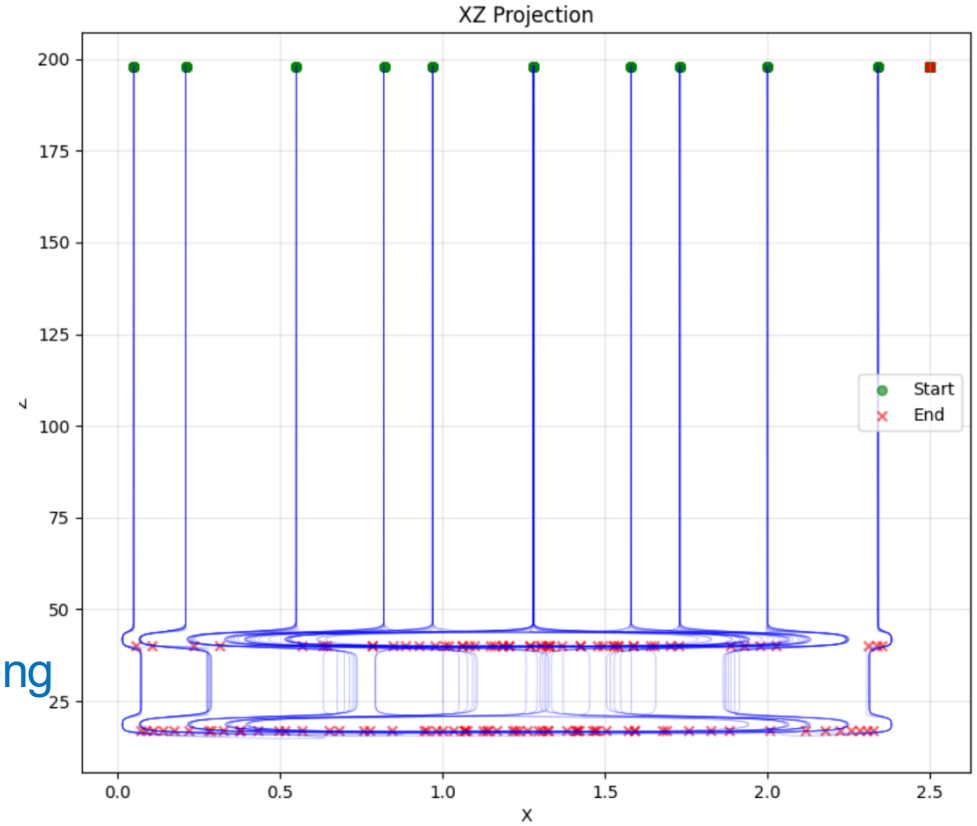
- **Previous issues:**
- Hard-coded values in drift and 3D weighting fields
- PCB gap set to 200 (no unit)
- Default 0.1 mm grid spacing → incorrect 20 mm distance




Ground plane in not included

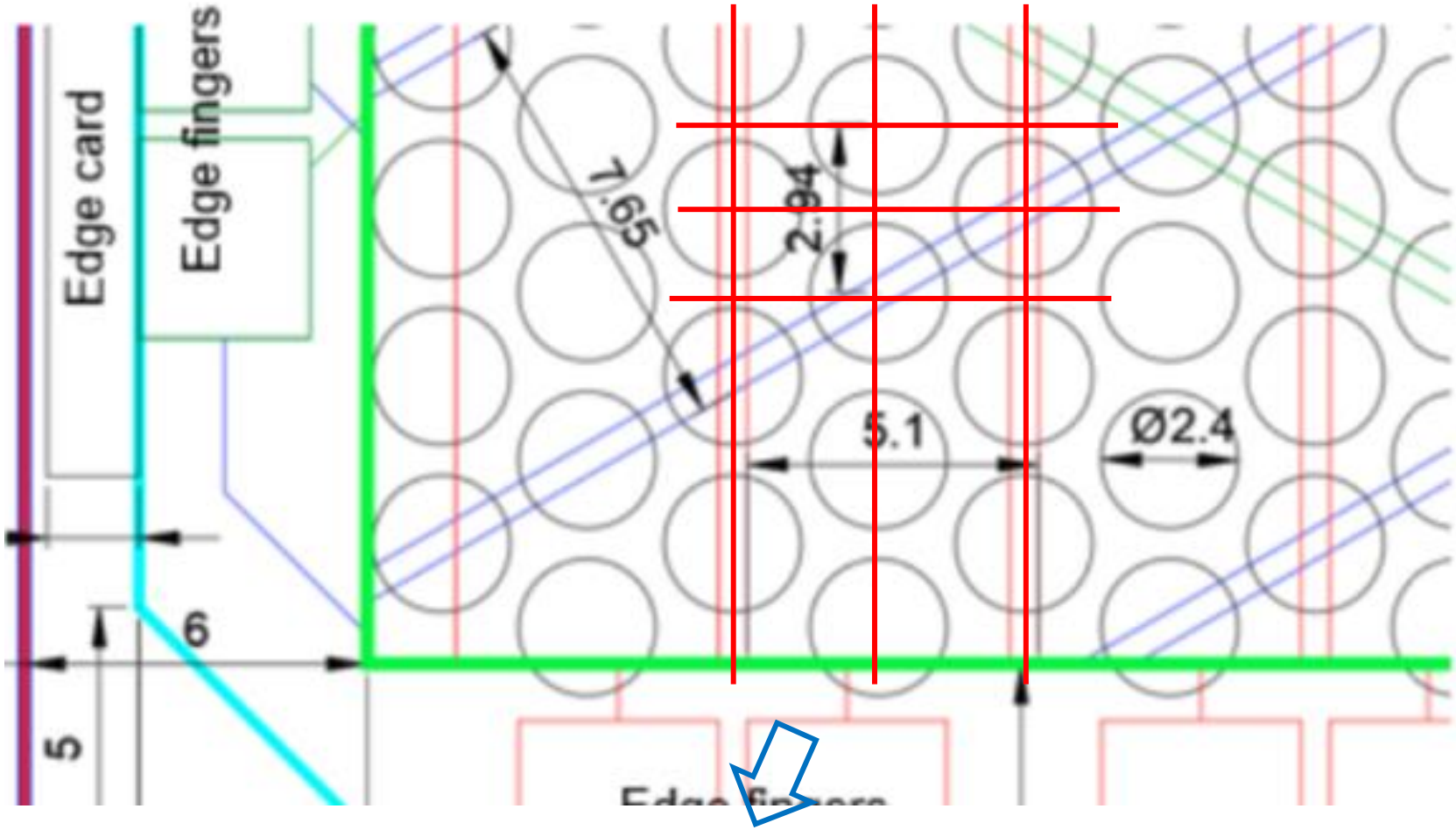
10mm;

20mm; wrong

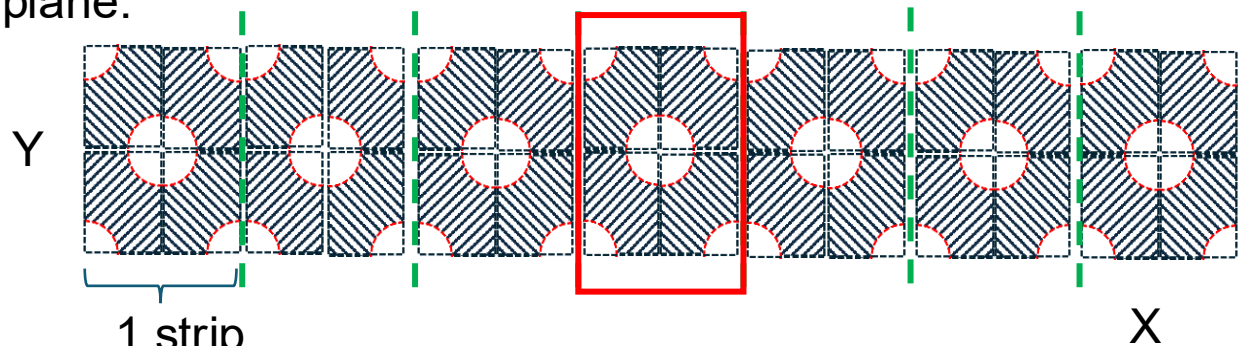



Due to the wrong gap, some electrons are collected at u plane;

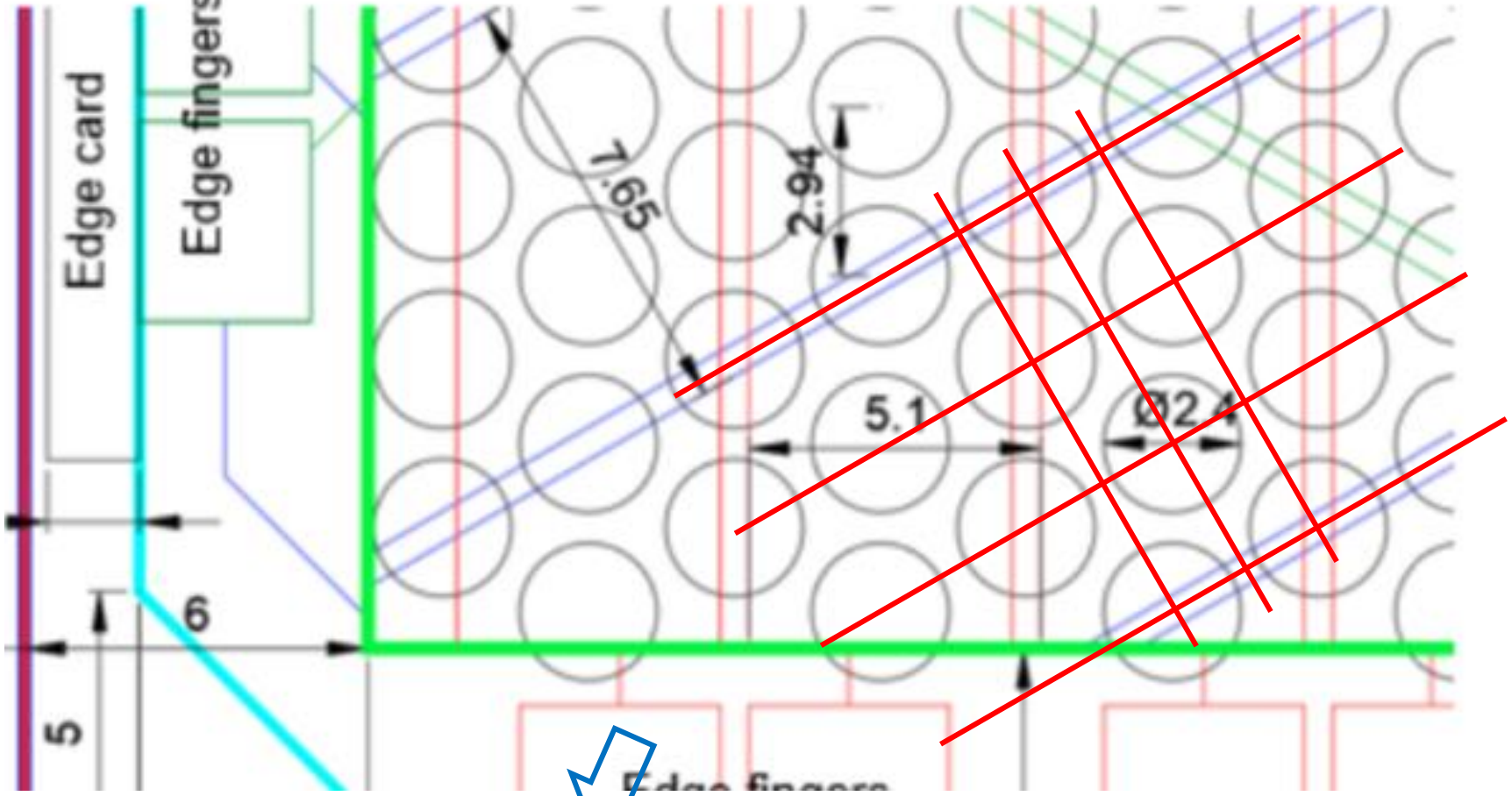
# w strip



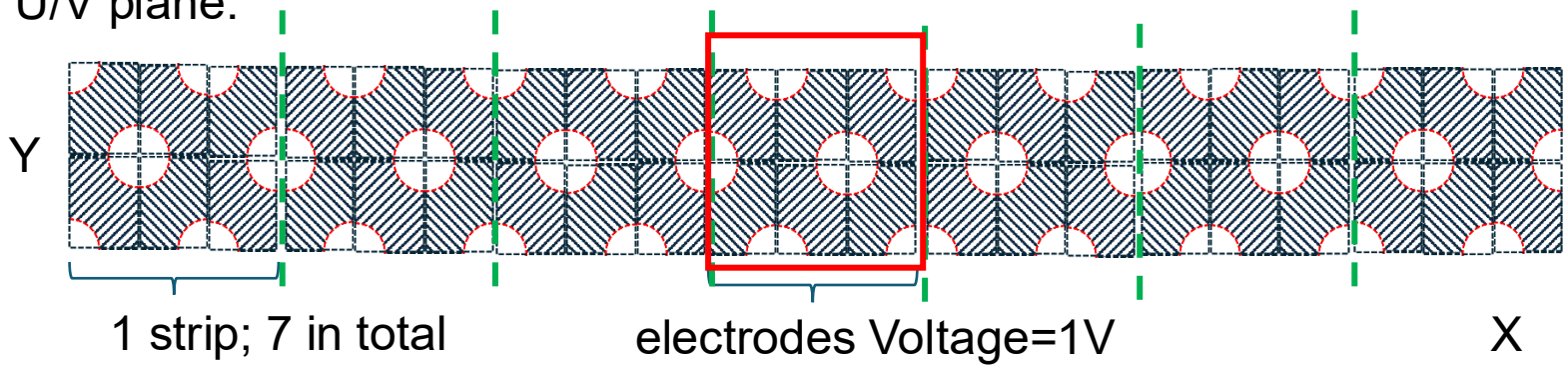

W plane:



# u&v strip

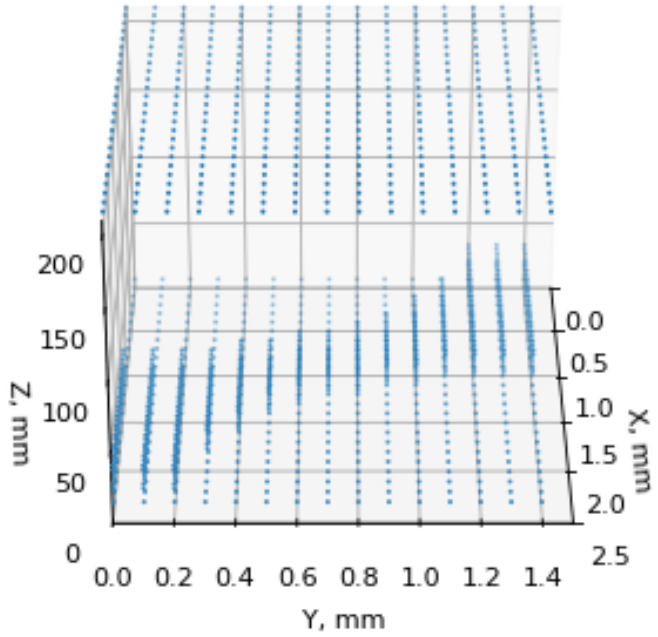



U/V plane:



# Updated geometry

### 3D drift field

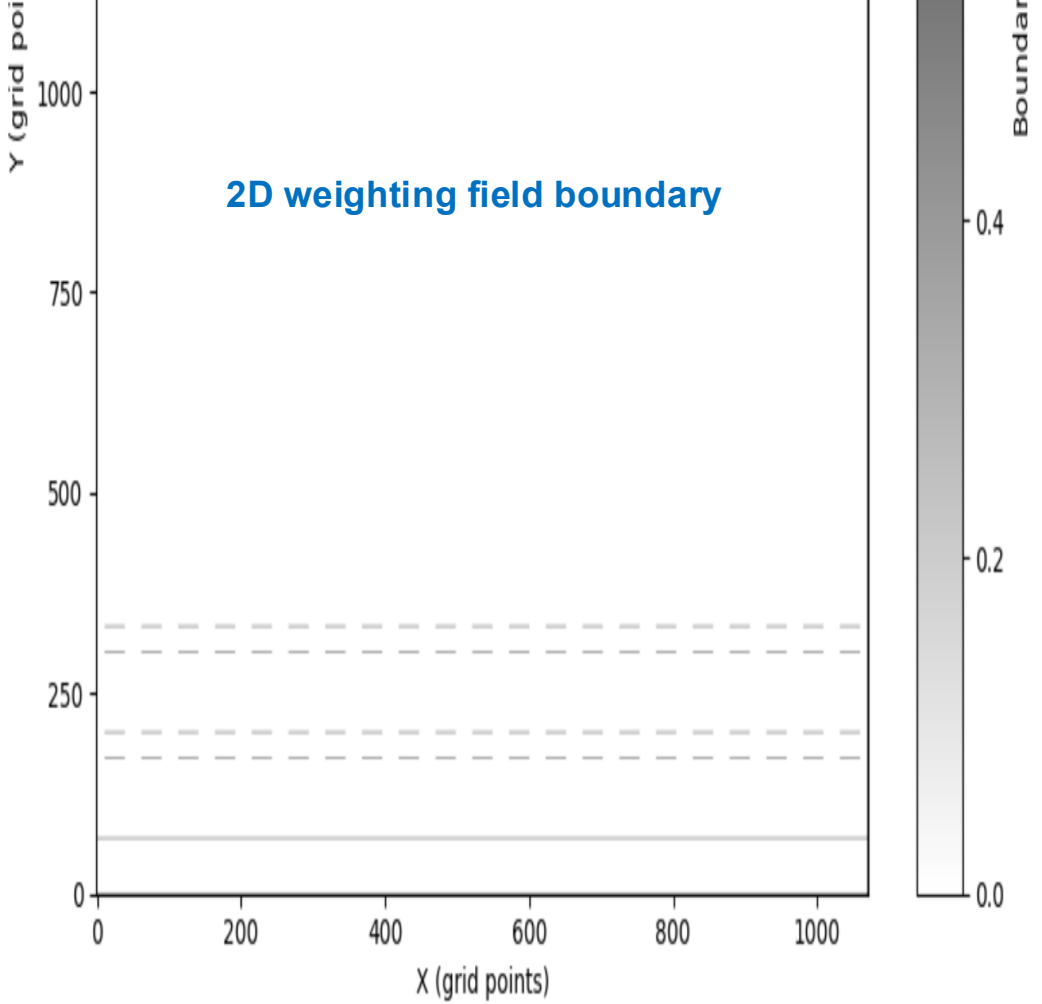



### 2D weighting field boundary

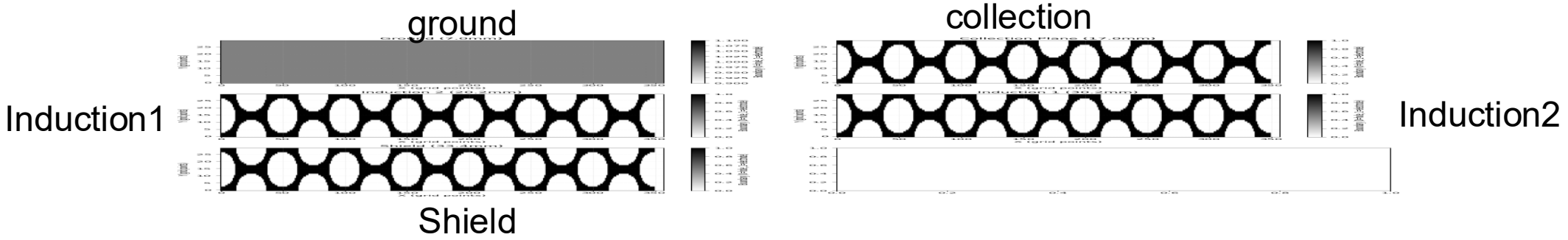
Shield
Induction2

Induction1
collection

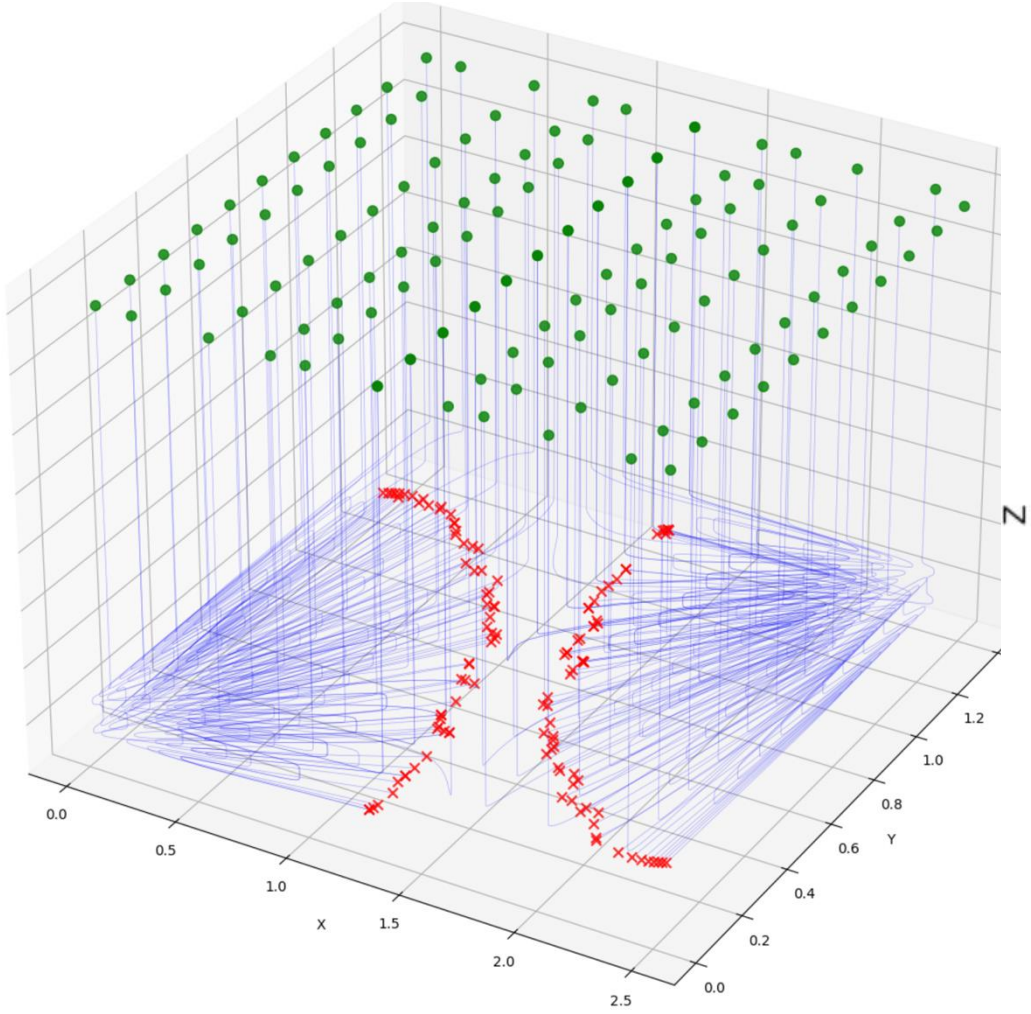
ground

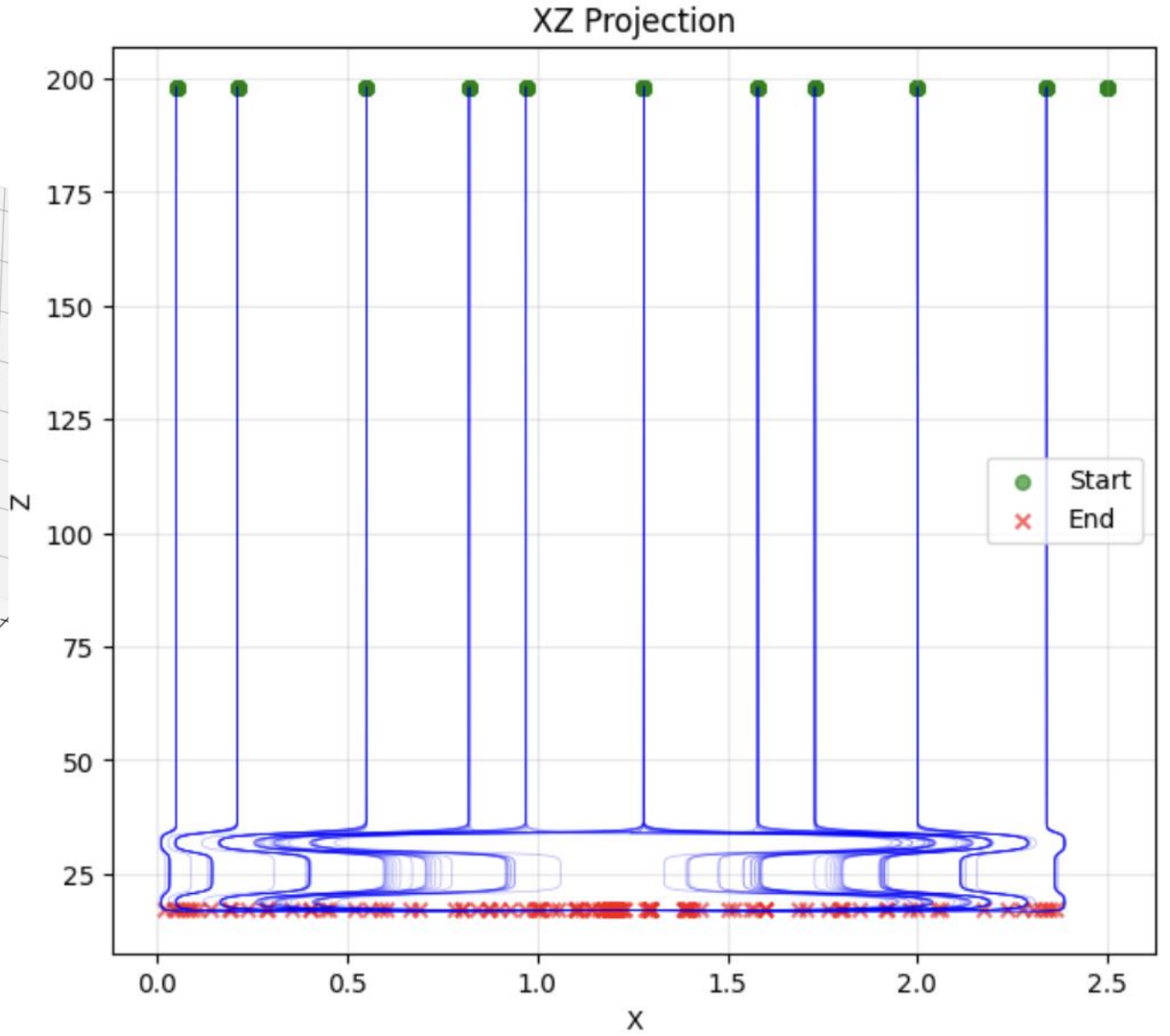



### 3D weighting field



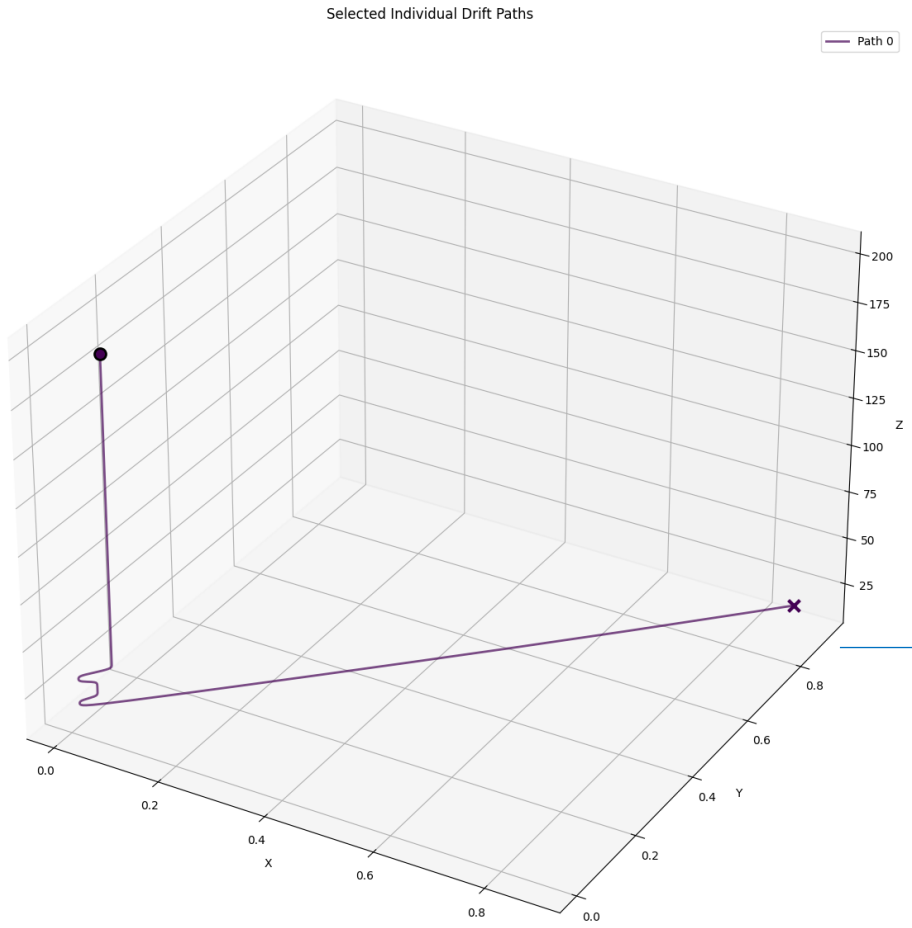
# electron paths

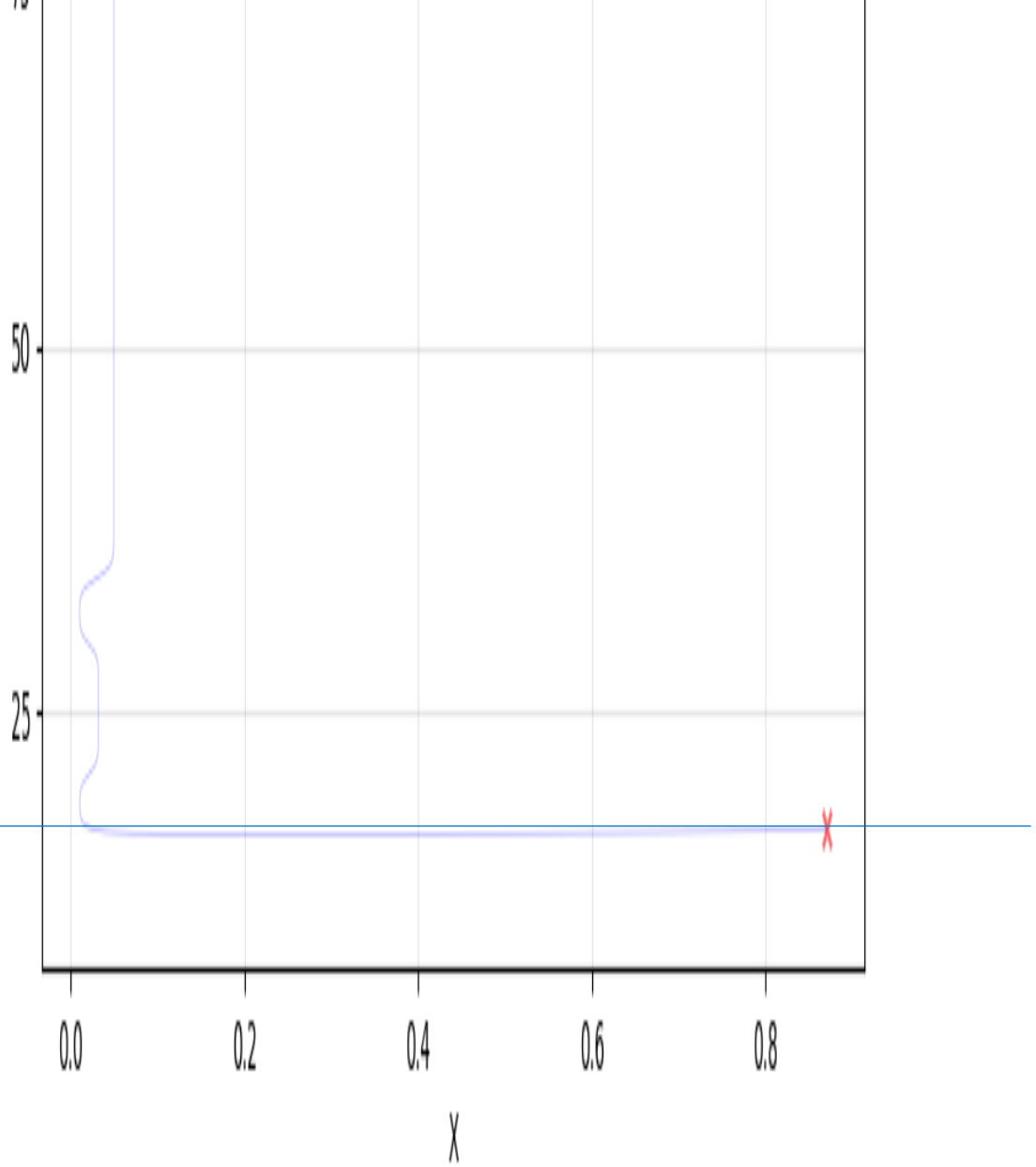



All electrons are collected at collection plane

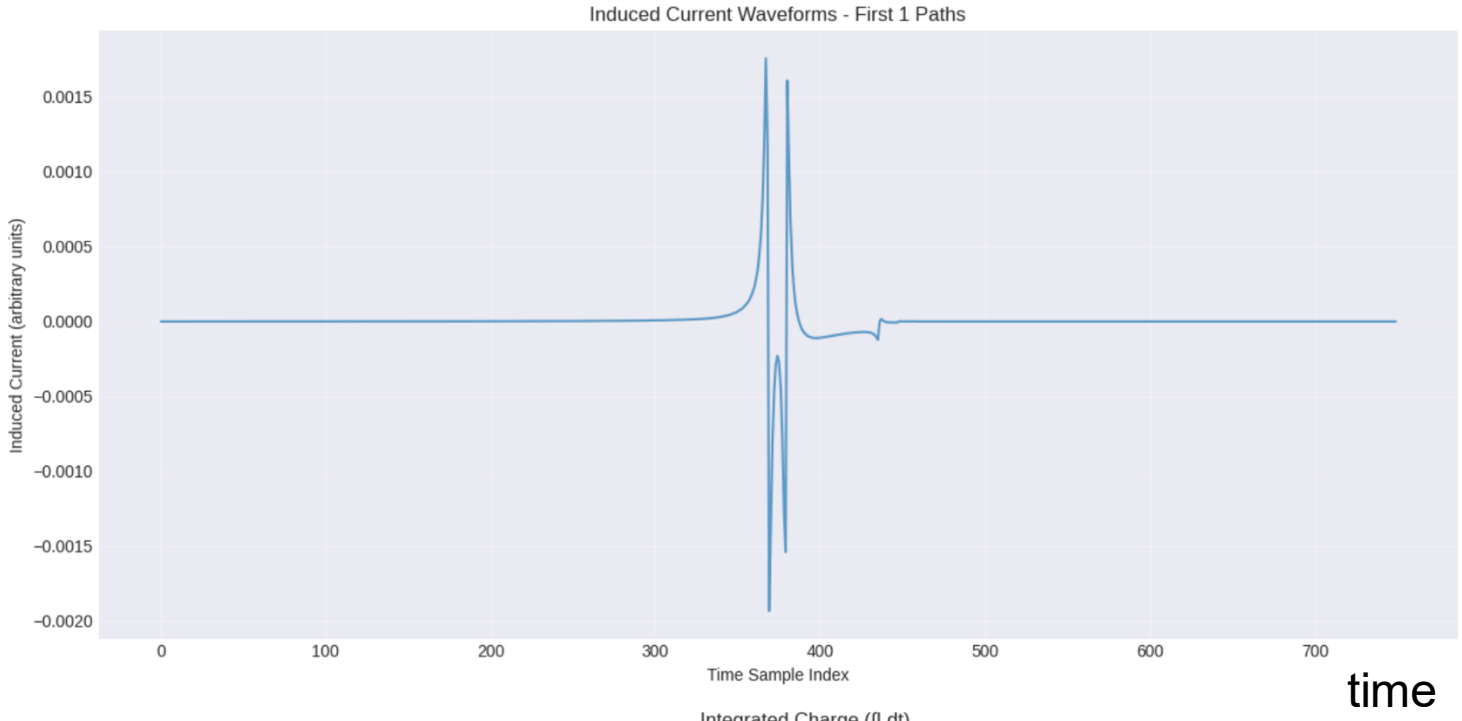
# Check a single path



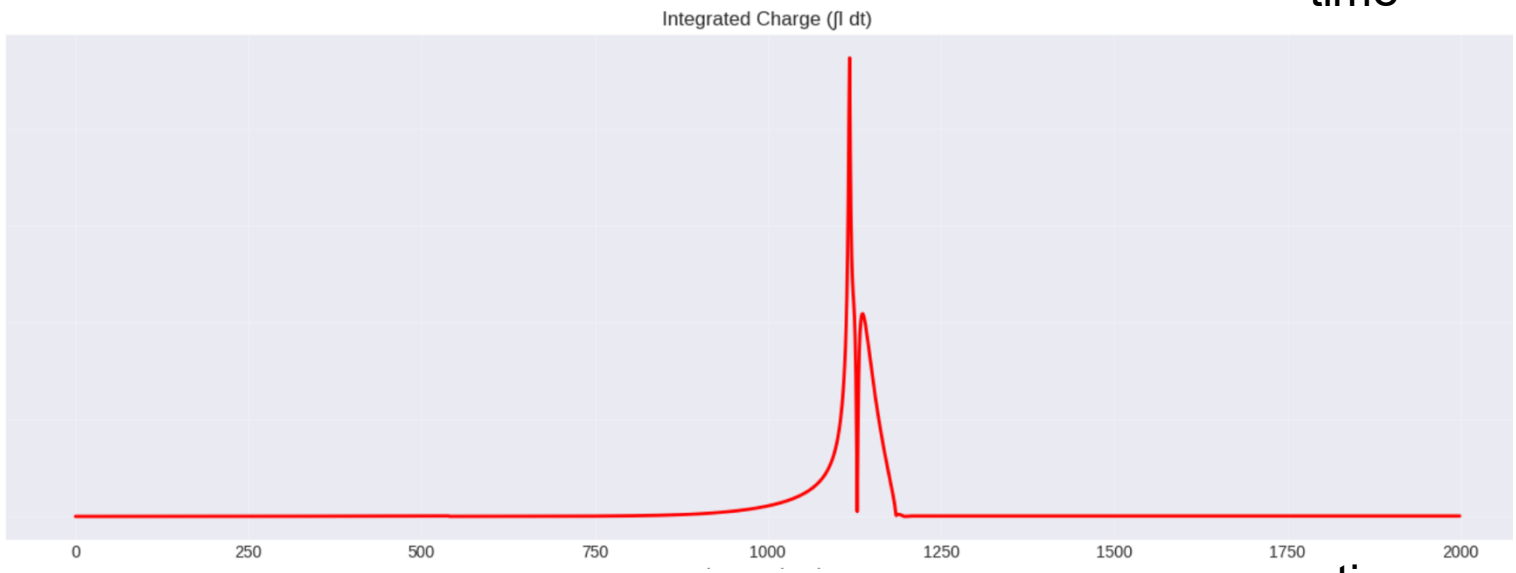
# Current; u

Current



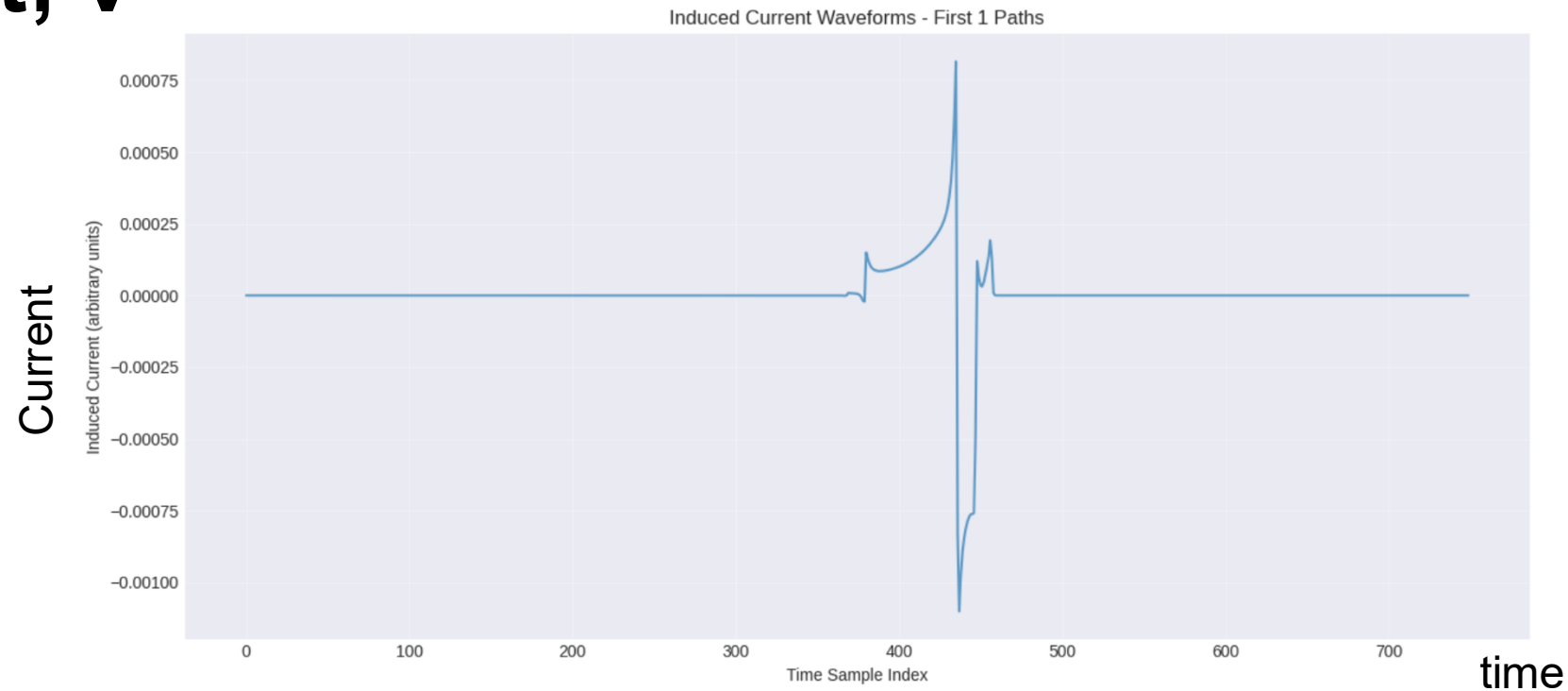

time

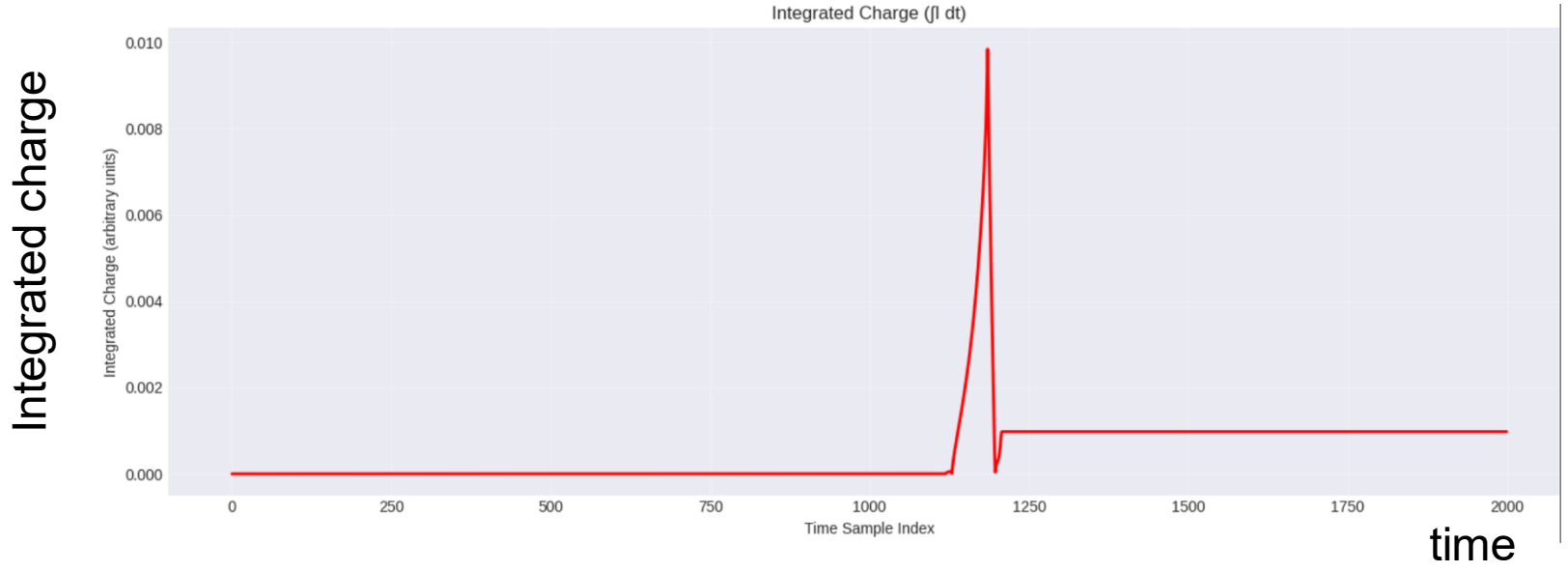
Integrated charge



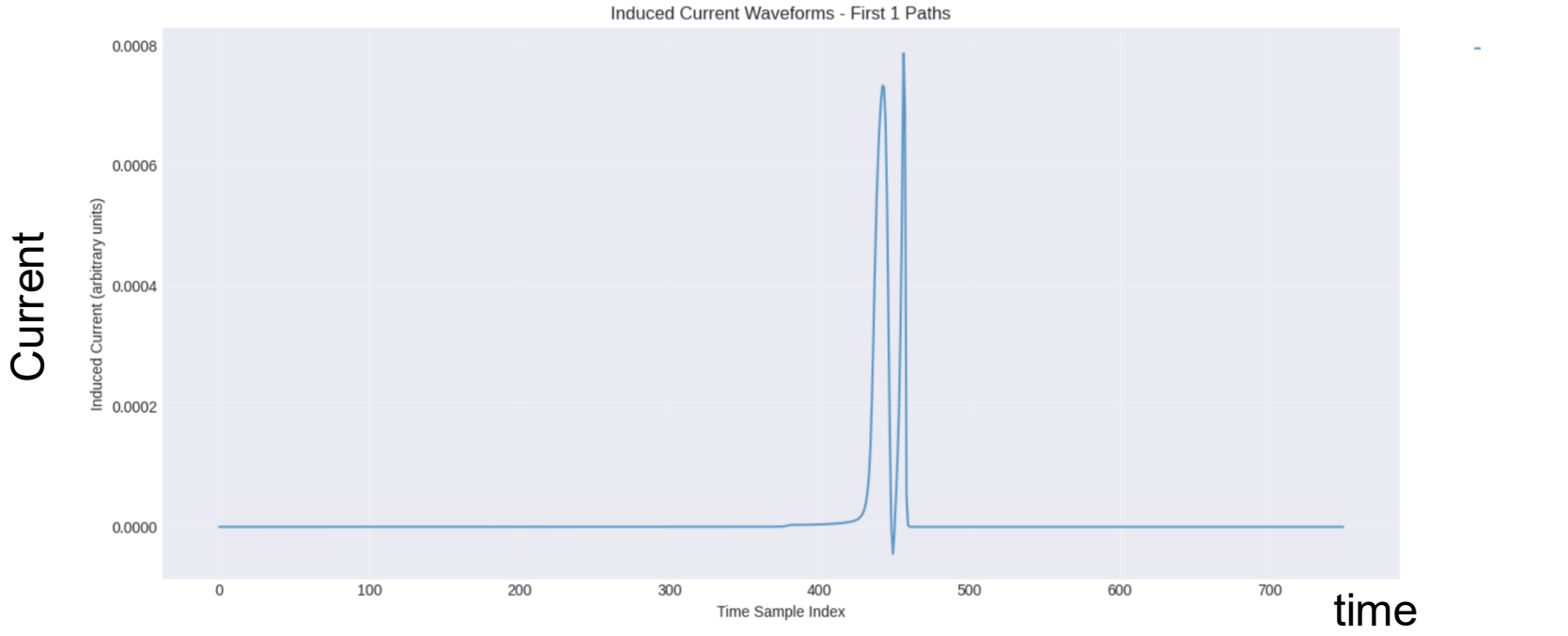

time

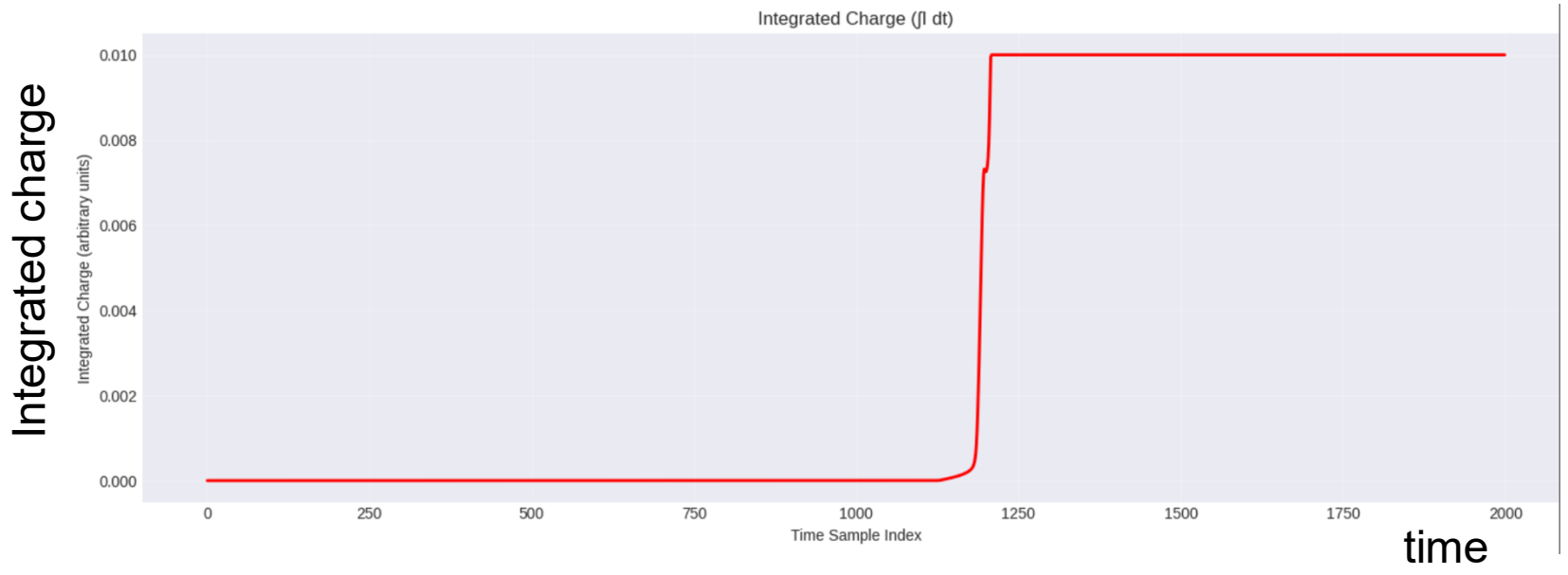
# Current; v


Induced Current Waveforms - First 1 Paths
Induced Current (arbitrary units)
0.00075
0.00050
0.00025
0.00000
−0.00025
−0.00050
−0.00075
−0.00100
0
100
200
300
400
500
600
700
Time Sample Index
Current
time

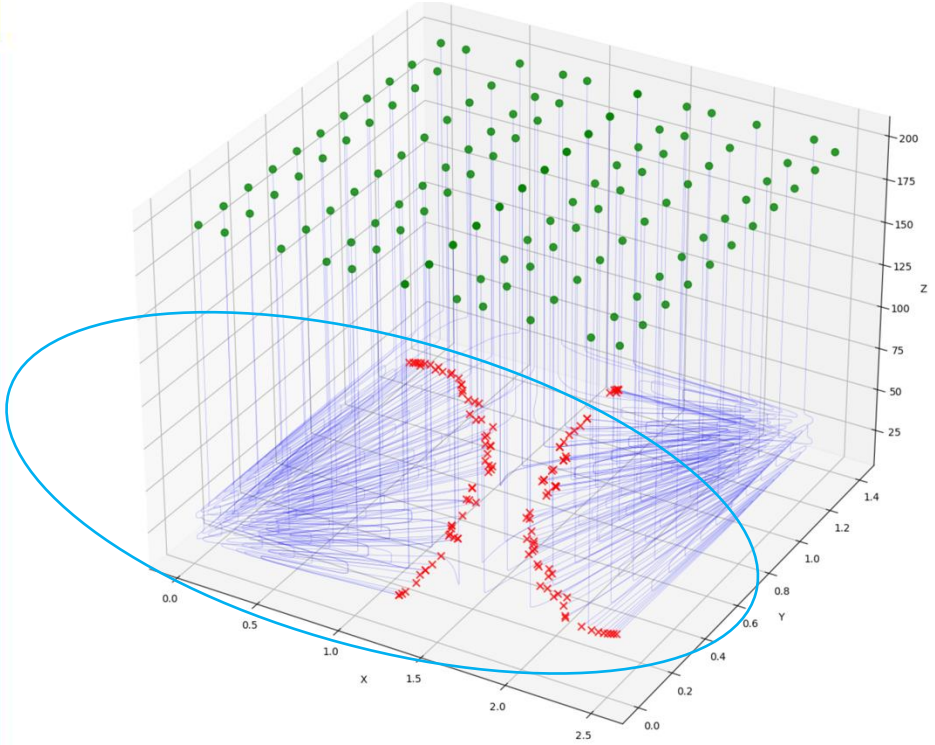

Integrated Charge (∫I dt)
Integrated Charge (arbitrary units)
0.010
0.008
0.006
0.004
0.002
0.000
0
250
500
750
1000
1250
1500
1750
2000
Time Sample Index
Integrated charge
time

# Current; w

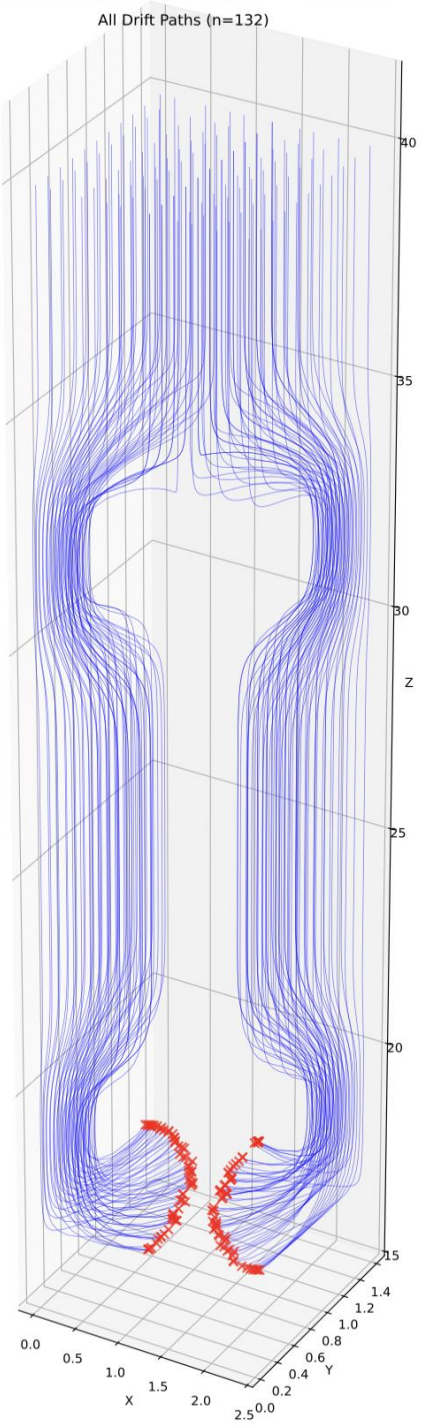

Induced Current Waveforms - First 1 Paths
Induced Current (arbitrary units)
0.0008
0.0006
0.0004
0.0002
0.0000
0
100
200
300
400
500
600
700
Time Sample Index
Current
time


Integrated Charge (∫I dt)
Integrated Charge (arbitrary units)
0.010
0.008
0.006
0.004
0.002
0.000
0
250
500
750
1000
1250
1500
1750
2000
Time Sample Index
Integrated charge
time

# Check Drift paths



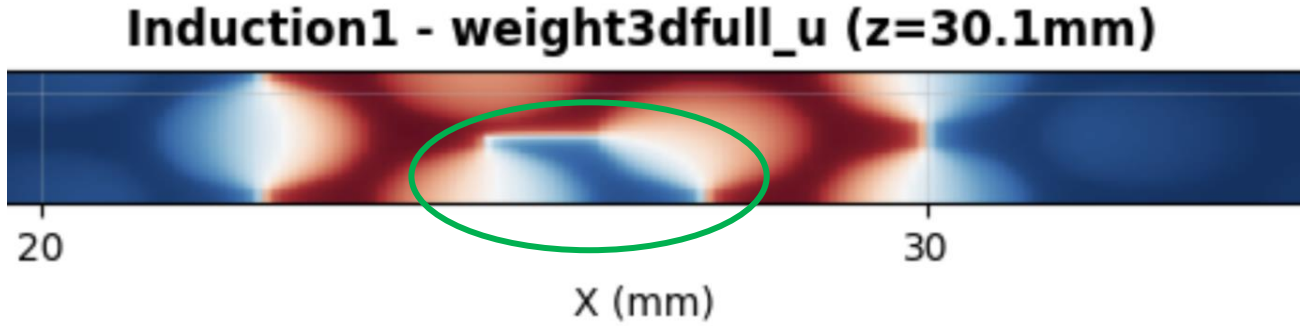

rescale this area in a more reasonable scale:

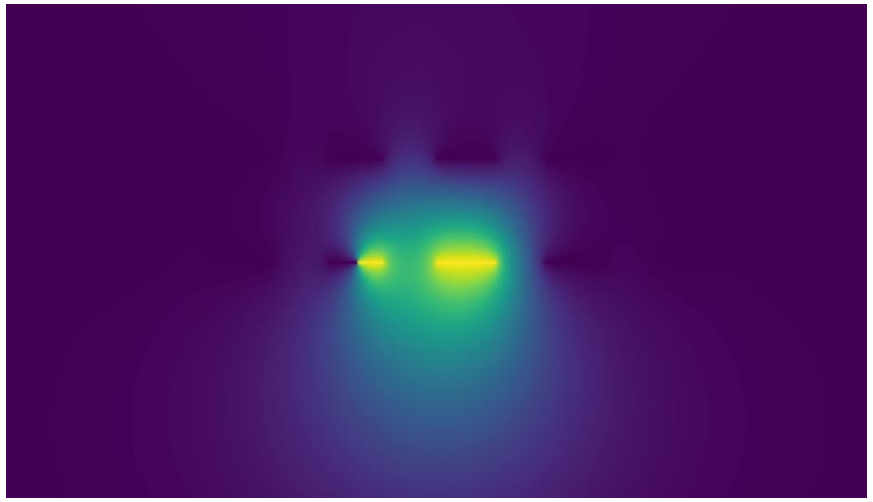



Drift field seems fine.

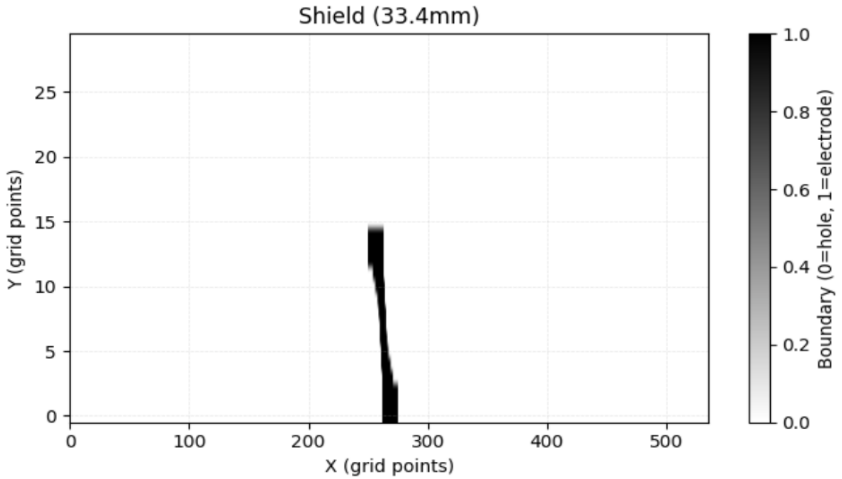
# Bug found in weighting field:

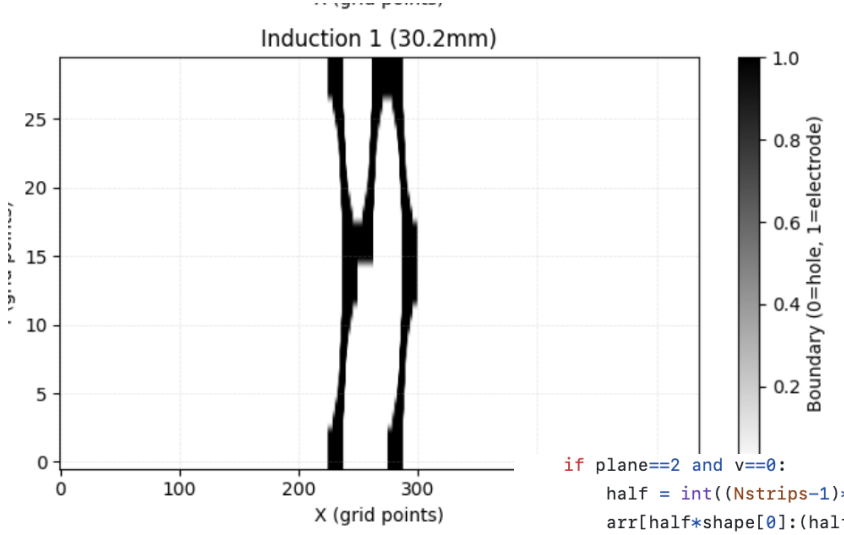
2D weighting field:



3D weighting field active wire setting has a bug



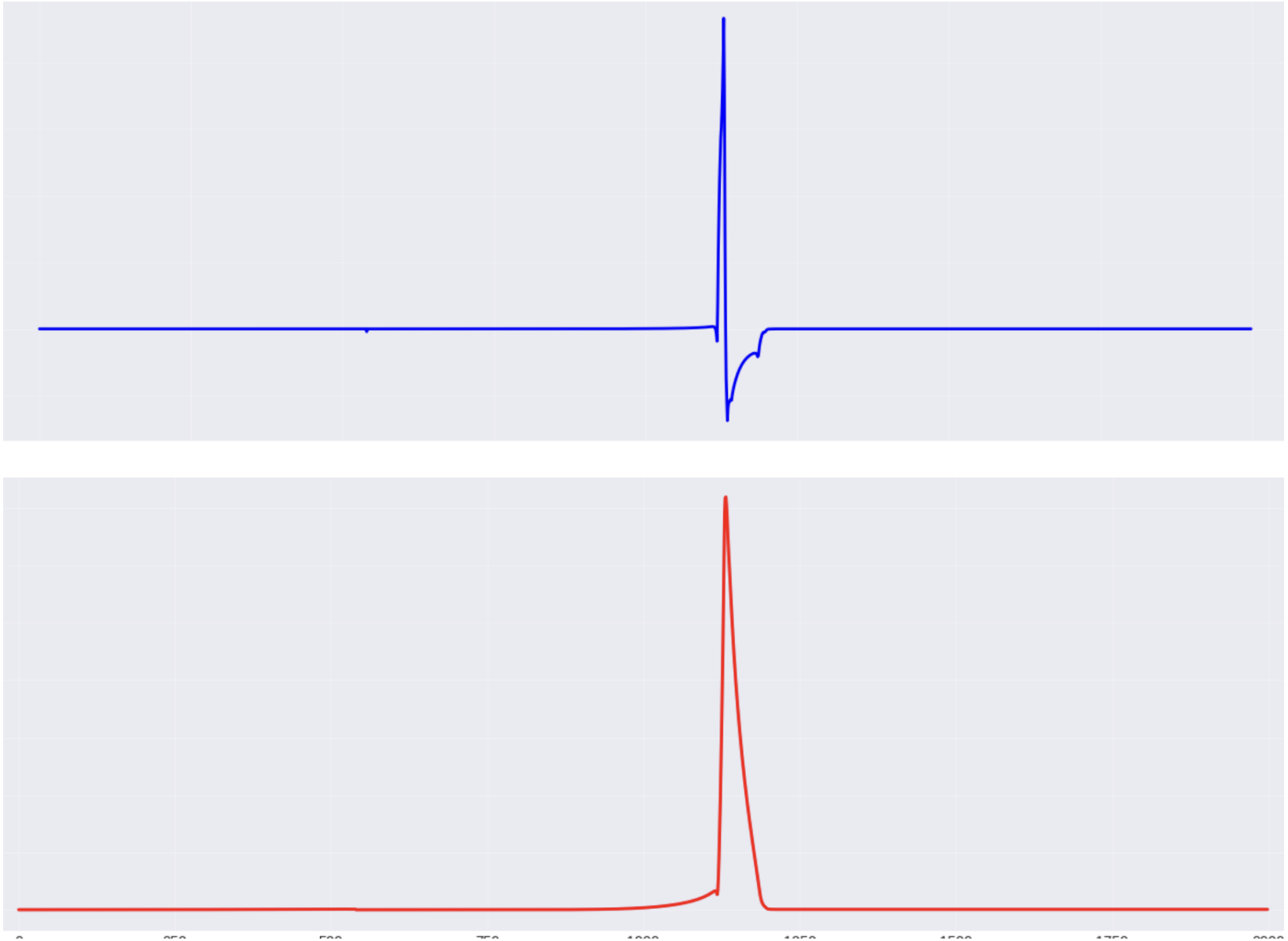




```
if plane==2 and v==0:
    half = int((Nstrips-1)*3/2)
    arr[half*shape[0]:(half+1)*shape[0],0:shape[1],pcb_low_edge] = qbarr_1[:,:,0]
    arr[half*shape[0]:(half+1)*shape[0],shape[1]:2*shape[1],pcb_low_edge] = qbarr_4[:,:,0]
    arr[(half+1)*shape[0]:(half+2)*shape[0],0:shape[1],pcb_low_edge+pcb_width] = qbarr_4[:,:,0]
    arr[(half+1)*shape[0]:(half+2)*shape[0],shape[1]:2*shape[1],pcb_low_edge] = qbarr_1[:,:,0]
    arr[(half+2)*shape[0]:(half+3)*shape[0],0:shape[1],pcb_low_edge] = qbarr_1[:,:,0]
    arr[(half+2)*shape[0]:(half+3)*shape[0],shape[1]:2*shape[1],pcb_low_edge] = qbarr_4[:,:,0]
```

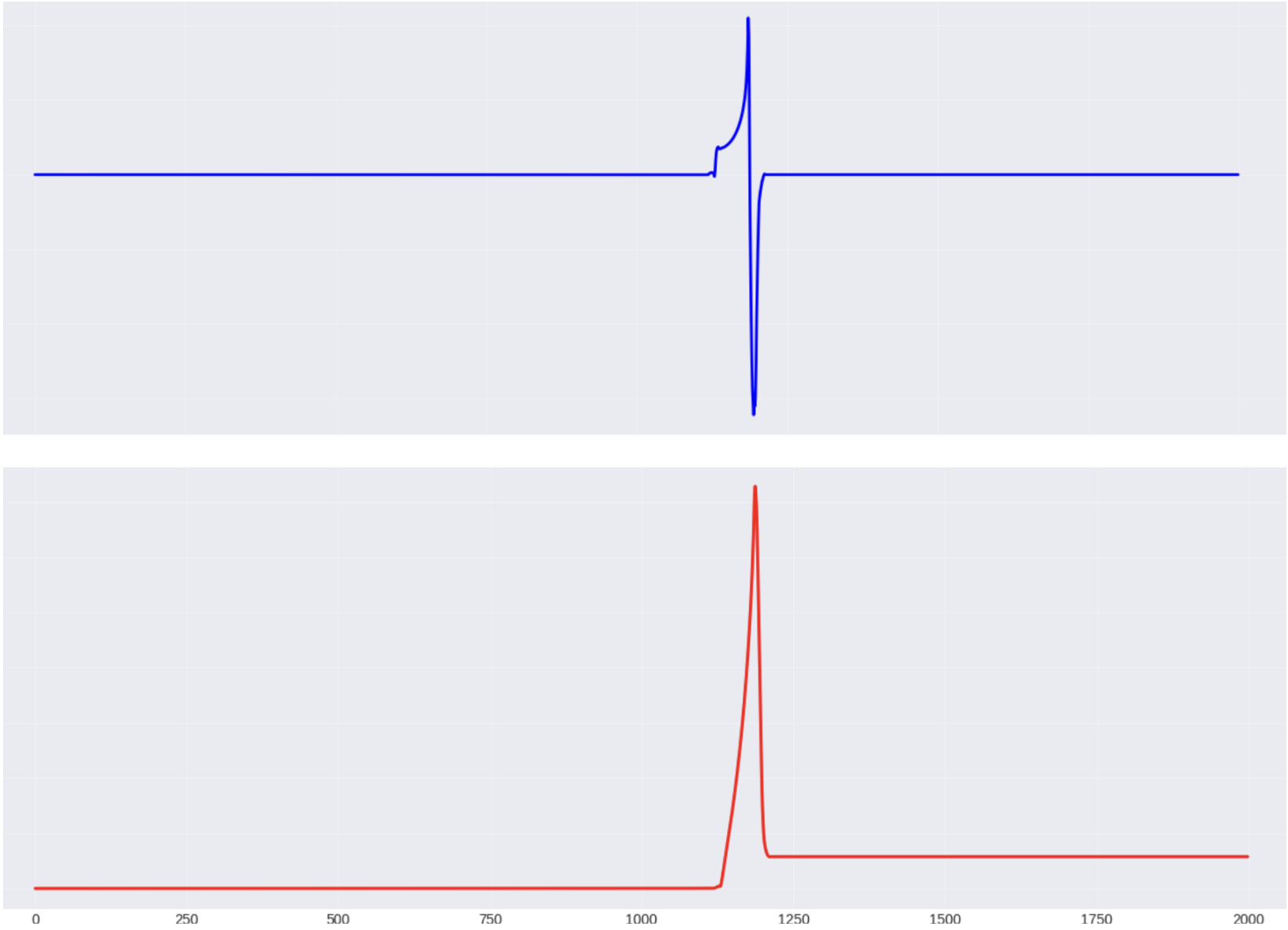
https://github.com/brettviren/pochoir/blob/confings_and_instructions/pochoir/gen_pcb_3Dstrips_30deg.py#L79C68-L79C79

# Averaged Current; u;

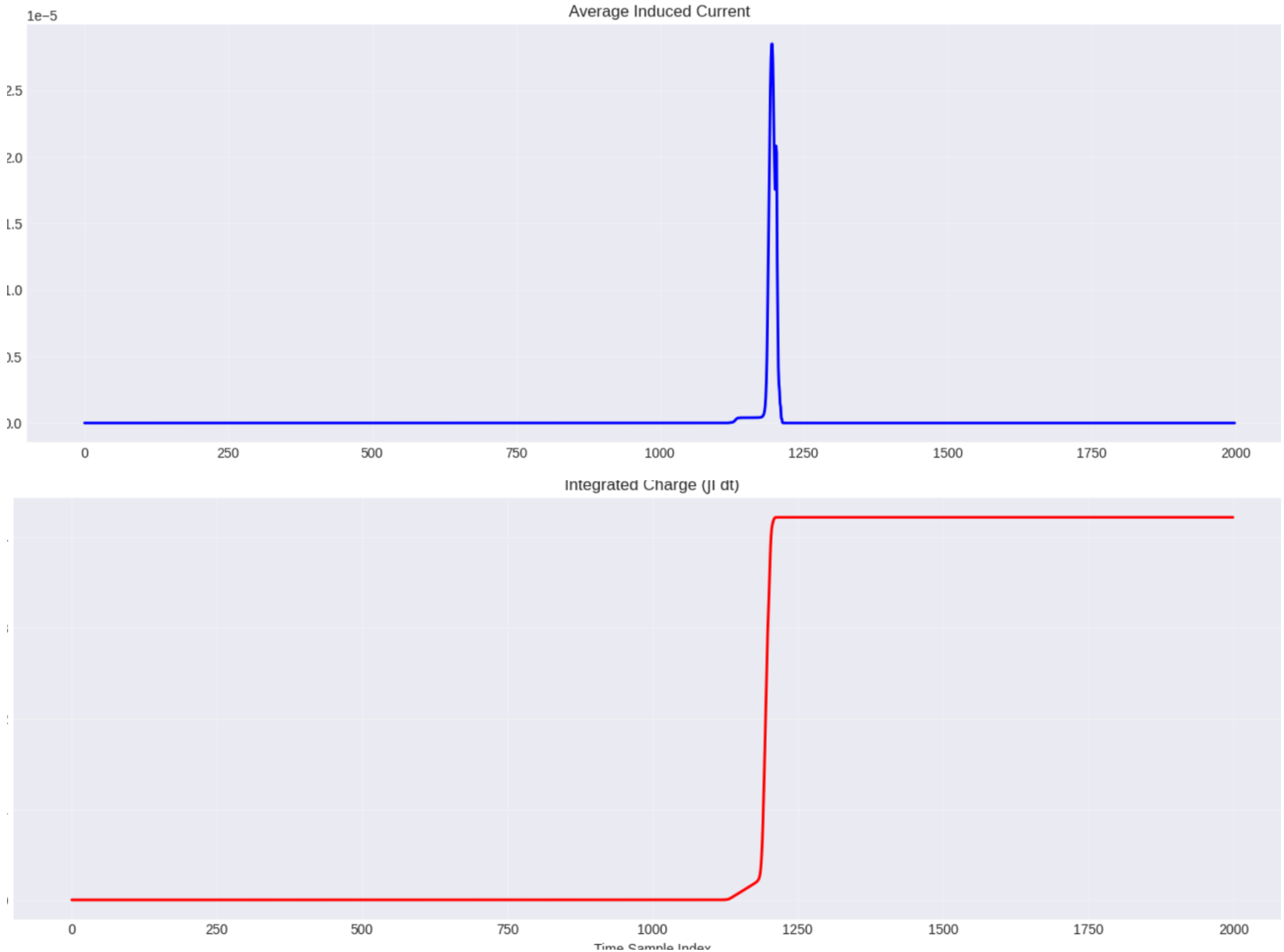
Averaged current for 132 paths inside small drift volume



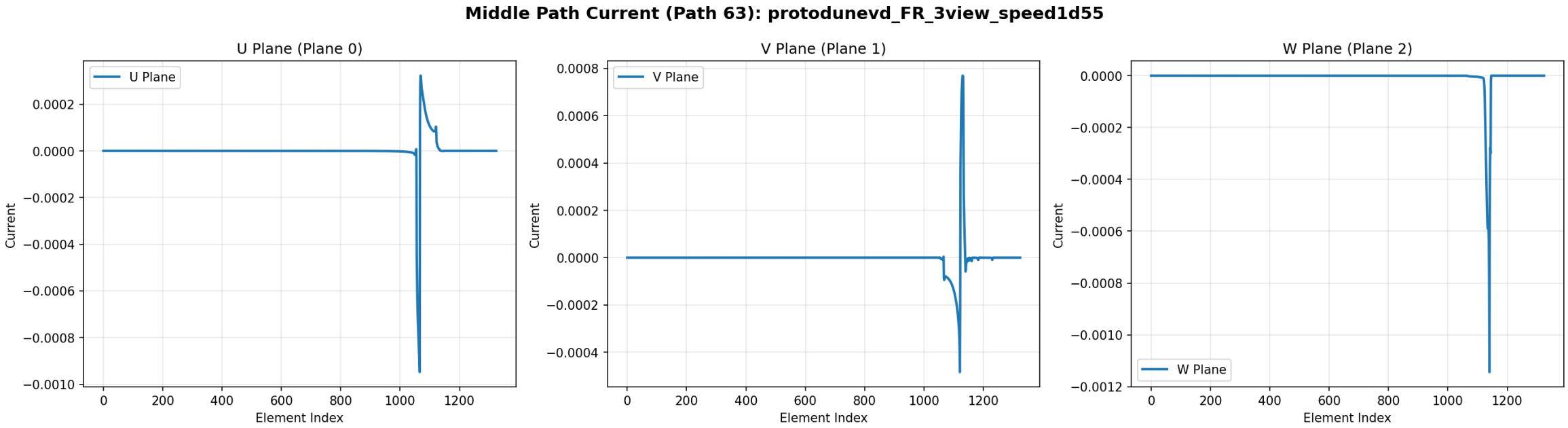
# Averaged Current; v



# Averaged Current; w

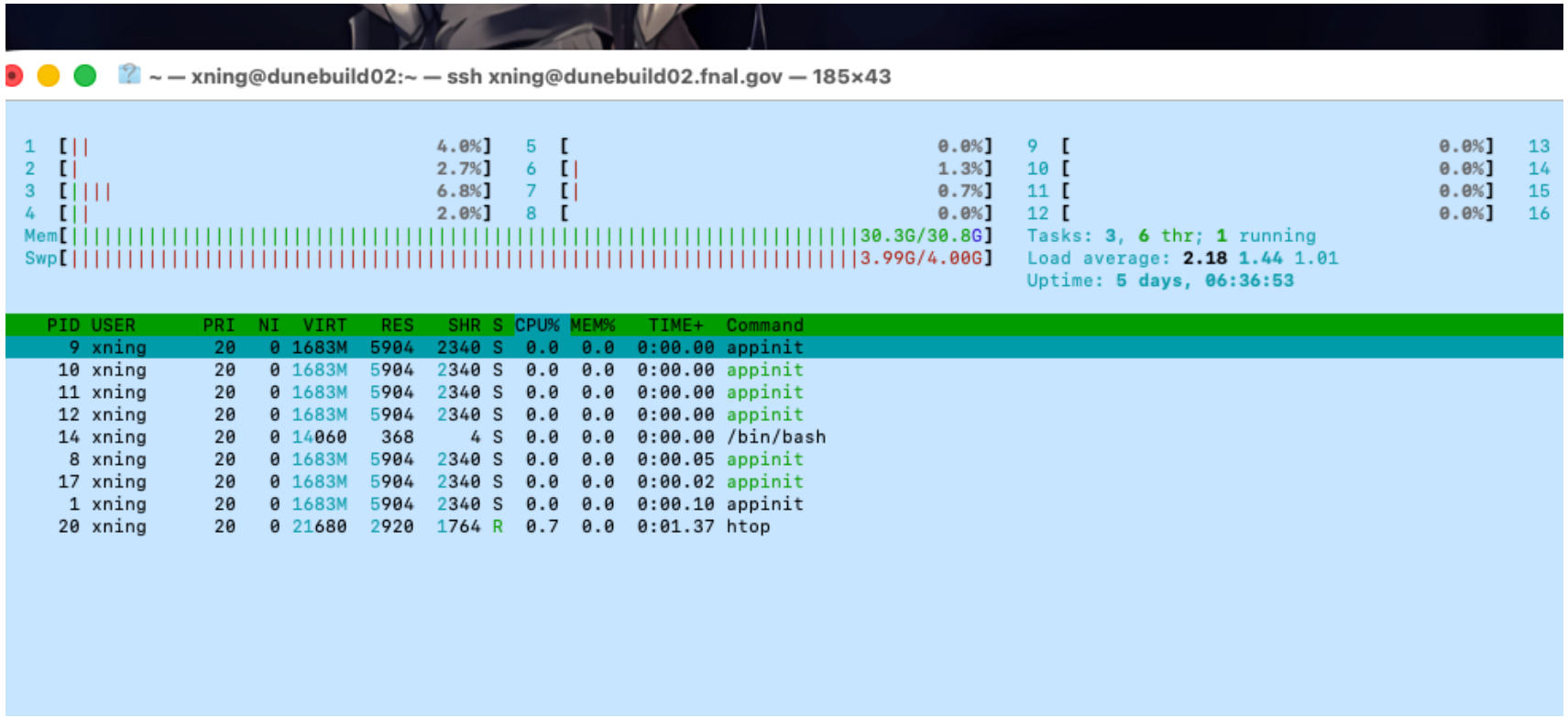


# From Sergey's original FR



# backup: imgaing crushed point

```
132176  [17:33:00.699] D [  img   ] <GridTiling:tiling-anode2-ms-active_3-face1> anode=2 face=1 slice=2124 ALLOC: creating SimpleBlobSet
132177  [17:33:00.699] D [  img   ] <GridTiling:tiling-anode2-ms-active_3-face1> anode=2 face=1 slice=2124 ALLOC: creating measures vector, nlayers=5
132178  [17:33:00.699] D [  img   ] <GridTiling:tiling-anode2-ms-active_3-face0> anode=2 face=0 slice=2124 MEMORY: RSS=1316 MB at start
132179  [17:33:00.699] D [  img   ] <GridTiling:tiling-anode2-ms-active_3-face0> anode=2 face=0 slice=2124 ALLOC: creating SimpleBlobSet
132180  [17:33:00.699] D [  img   ] <GridTiling:tiling-anode2-ms-active_3-face0> anode=2 face=0 slice=2124 ALLOC: creating measures vector, nlayers=5
132181  [17:33:00.699] D [  img   ] <GridTiling:tiling-anode2-ms-active_2-face1> anode=2 face=1 slice=2124 MEMORY: RSS=1316 MB at start
132182  [17:33:00.699] D [  img   ] <GridTiling:tiling-anode2-ms-active_2-face0> anode=2 face=0 slice=2124 MEMORY: RSS=1316 MB at start
132183  [17:33:00.700] D [  img   ] <GridTiling:tiling-anode2-ms-active_1-face1> anode=2 face=1 slice=2124 MEMORY: RSS=1316 MB at start
132184  [17:33:00.700] D [  img   ] <GridTiling:tiling-anode2-ms-active_1-face1> anode=2 face=1 slice=2124 ALLOC: creating SimpleBlobSet
132185  [17:33:00.700] D [  img   ] <GridTiling:tiling-anode2-ms-active_1-face1> anode=2 face=1 slice=2124 ALLOC: creating measures vector, nlayers=5
132186  [17:33:00.700] D [  img   ] <GridTiling:tiling-anode2-ms-active_1-face0> anode=2 face=0 slice=2124 MEMORY: RSS=1316 MB at start
132187  [17:33:00.700] D [  img   ] <GridTiling:tiling-anode2-ms-active_1-face0> anode=2 face=0 slice=2124 ALLOC: creating SimpleBlobSet
132188  [17:33:00.700] D [  img   ] <GridTiling:tiling-anode2-ms-active_1-face0> anode=2 face=0 slice=2124 ALLOC: creating measures vector, nlayers=5
132189  [17:33:00.700] D [  img   ] <GridTiling:tiling-anode2-ms-active_0-face1> anode=2 face=1 slice=2123 MEMORY: RSS=1316 MB at start
132190  [17:33:00.700] D [  img   ] <GridTiling:tiling-anode2-ms-active_0-face0> anode=2 face=0 slice=2123 MEMORY: RSS=1316 MB at start
132191  [17:33:00.700] D [  img   ] <GridTiling:tiling-anode2-ms-active_0-face1> anode=2 face=1 slice=2124 MEMORY: RSS=1316 MB at start
132192  [17:33:00.700] D [  img   ] <GridTiling:tiling-anode2-ms-active_0-face0> anode=2 face=0 slice=2124 MEMORY: RSS=1316 MB at start
132193  [17:33:00.701] D [  glue  ] <FrameFanout:sn_mag_fout_0_0> call=1: see EOS
132194  [17:33:00.705] D [  glue  ] <FrameFanout:sn_mag_fout_1_0> call=1: see EOS
132195  [17:33:00.705] D [  glue  ] <ChannelSelector:chsel2> see EOS at call=0
132196  [17:33:00.705] D [sigproc ] <OmnibusNoiseFilter:nf2> EOS at call=1
132197  [17:33:00.705] D [sigproc ] <OmnibusSigProc:anode2sigproc2> EOS at call=1 anode=2
132198  [17:33:00.705] D [  img   ] <CMMModifier:cmm-mod-anode2> see EOS at call=1
132199  [17:33:00.705] D [  img   ] <FrameMasking:frame-masking-anode2> see EOS
132200  [17:33:00.705] D [  img   ] <ChargeErrorFrameEstimator:cefe-anode2> see EOS
132201  [17:33:00.705] D [  glue  ] <FrameFanout:fan_active_masked-anode2> call=1: see EOS
132202  [17:33:00.706] D [  glue  ] <FrameFanout:multi_masked_slicing_tiling_anode2-ms-masked> call=1: see EOS
132203  [17:33:00.706] D [  img   ] <MaskSlice:slicing-anode2-ms-masked_2> EOS
132204  [17:33:00.706] D [  glue  ] <SliceFanout:slicefanout-anode2-ms-masked_2> sending out 2 EOSes
132205  [17:33:00.706] D [  img   ] <GridTiling:tiling-anode2-ms-masked_2-face1> EOS
132206  [17:33:00.706] D [  img   ] <GridTiling:tiling-anode2-ms-masked_2-face0> EOS
132207  [17:33:00.706] D [  glue  ] <BlobSetSync:blobsetsync-anode2-ms-masked_2> EOS
132208  [17:33:00.706] D [  img   ] <MaskSlice:slicing-anode2-ms-masked_1> EOS
132209  [17:33:00.706] D [  glue  ] <SliceFanout:slicefanout-anode2-ms-masked_1> sending out 2 EOSes
132210  [17:33:00.706] D [  img   ] <GridTiling:tiling-anode2-ms-masked_1-face1> EOS
```


~ — xning@dunebuild02:~ — ssh xning@dunebuild02.fnal.gov — 185×43
1 [|| 4.0%] 5 [ 0.0%] 9 [ 0.0%] 13
2 [| 2.7%] 6 [| 1.3%] 10 [ 0.0%] 14
3 [|||| 6.8%] 7 [| 0.7%] 11 [ 0.0%] 15
4 [|| 2.0%] 8 [ 0.0%] 12 [ 0.0%] 16
Mem[||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||30.3G/30.8G]
Swp[||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||3.99G/4.00G]
Tasks: 3, 6 thr; 1 running
Load average: 2.18 1.44 1.01
Uptime: 5 days, 06:36:53
PID USER PRI NI VIRT RES SHR S CPU% MEM% TIME+ Command
9 xning 20 0 1683M 5904 2340 S 0.0 0.0 0:00.00 appinit
10 xning 20 0 1683M 5904 2340 S 0.0 0.0 0:00.00 appinit
11 xning 20 0 1683M 5904 2340 S 0.0 0.0 0:00.00 appinit
12 xning 20 0 1683M 5904 2340 S 0.0 0.0 0:00.00 appinit
14 xning 20 0 14060 368 4 S 0.0 0.0 0:00.00 /bin/bash
8 xning 20 0 1683M 5904 2340 S 0.0 0.0 0:00.05 appinit
17 xning 20 0 1683M 5904 2340 S 0.0 0.0 0:00.02 appinit
1 xning 20 0 1683M 5904 2340 S 0.0 0.0 0:00.10 appinit
20 xning 20 0 21680 2920 1764 R 0.7 0.0 0:01.37 htop